MEDRAD®

Veris™ 8600
Patient Monitoring System

Service Manual

Veris™
MR MONITORING SYSTEM

p/n 3010798 Revision 0
Date 09/05

CE 0123

Serial Numbers and date of installation must be supplied when ordering replacement parts or inquiring about service. For convenience, record the following information below:

OWNER:	
DATE INSTALLED:	
SYSTEM SERIAL NUMBER:	
MONITOR SERIAL NUMBER:	
BASE SERIAL NUMBER:	
POWER SUPPLY SERIAL NUMBER:	
ECG MODULE SERIAL NUMBER:	
REMOTE DISPLAY SERIAL NUMBER:	

The information and specifications included in this publication were in effect at the time of approval for printing. MEDRAD, Inc., reserves the right, however, to discontinue or otherwise change specifications or design at anytime without notice and without incurring any obligation whatsoever.

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1 *Introduction*

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Trademarks

MEDRAD ***Veris***™ is a trademark of MEDRAD, Inc.

Restricted Sale

U.S. Federal law restricts the sale of this device on or by the order of a physician.

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Applicability

This manual applies to the MEDRAD ***Veris*** 8600 patient monitor and to the power supply and ECG module used with the MEDRAD ***Veris*** 8600 patient monitor. This manual also applies to the optional MEDRAD ***Veris*** 8600 remote display.

Purpose

The purpose of this manual is intended to provide instructions for servicing the MEDRAD ***Veris*** 8600 patient monitor and optional remote display safely and accurately. It is intended for those qualified to service the patient monitor, whether they be MEDRAD Service Personnel, Certified Laboratory Service Technicians, or MEDRAD authorized international dealers.

Important Safety Notice

The information in this manual is intended for people with adequate backgrounds and experience in electronics and electromechanical devices. Any attempt to repair a sophisticated medical device such as the patient monitor may result in personal injury, property damage, or patient injury.

Intended Use

Refer to the *MEDRAD **Veris** 8600 Patient Monitor Operation Manual*.

Certifications

MEDRAD ***Veris*** patient monitors and remote displays are equipped to operate at 100-240VAC, 50/60 Hz, and designed to be in compliance with EN 60601-1 (Safety), and EN 60601-1-2 (EMC/ Emissions).

MEDRAD, Inc. is EN-ISO 9001/EN 13485 certified.

MEDRAD Europe B.V. is EN-ISO 9002/EN 13488 certified. (European Medical Device Directive 93/42/EEC).

Nihon MEDRAD KK is ISO 9001/ISO 13485 certified.

Medrad Service - Additional Information Regarding Compliance to IEC 60601-1-2 / 2001 2nd Edition

The information contained herein is intended to reflect conformance to IEC-60601-1-2 / 2001 2nd edition Standards.

The following statements are cautions. Cautions advise of circumstances that could result in damage to the device. Read and understand these cautions before operating the system.

⚠CAUTION⚠

- System may disarm or fail to operate when exposed to high magnetic fields. Portable and mobile RF communications equipment can affect the system.
- FOR PROPER OPERATION, use only accessories and options provided by MEDRAD that are designed specifically for the system. Other non-MEDRAD approved accessories or options may cause equipment damage or may result in increased emissions or decreased immunity of the system. System accessories listed in the operation manual comply with the requirements of electromagnetic emissions and immunity standards IEC-60601-1-2 / 2001 2nd edition.
- DO NOT USE SYSTEM ADJACENT TO OR STACKED WITH OTHER EQUIPMENT. If adjacent or stacked use is necessary, the system should be observed to verify normal operation in the configuration in which it will be used.

Recommended separation distances between portable and mobile RF communications equipment and the system

The system is intended for use in an electromagnetic environment in which radiated RF disturbances are controlled. The customer or the user of the system can help prevent electromagnetic interference by maintaining a minimum distance between portable and mobile RF communications equipment (transmitters) and the system as recommended below, according to the maximum output power of the communications equipment.

Rated maximum output power of transmitter *W*	Separation distance according to frequency of transmitter *m*		
	150 KHz to 80 MHz $d = [3.5/V1]\sqrt{p}$	80 MHz to 800 MHz $d = [3.5/E1]\sqrt{p}$	800 MHz to 2.5 GHz $d = [7/E1]\sqrt{p}$
0.01	0.12	0.12	0.23
0.1	0.37	0.37	0.74
1	1.17	1.17	2.33
10	3.69	3.69	7.38
100	11.67	11.67	23.33

For transmitters rated at a maximum output power not listed above, the recommended separation distance *d* in meters (*m*) can be estimated using the equation applicable to the frequency of the transmitter, where *p* is the maximum output power rating of the transmitter in watts (*W*) according to the transmitter manufacturer.
NOTE 1 At 80 MHz and 800 MHz, the separation distance for the higher frequency applies.
NOTE 2 These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects and people.

SYSTEM REQUIRES SPECIAL PRECAUTIONS REGARDING EMC.

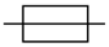
Install and put into service according to the EMC information provided below:

Guidance and manufacturer's declaration - electromagnetic emissions		
The system is intended for use in the electromagnetic environment specified below. The customer or user of the system should assure that it is used in such an environment.		
Emissions test	**Compliance**	**Electromagnetic environment - guidance**
RF emissions CISPR 11	Group 1	The system uses RF energy only for its internal function. Therefore, its RF emissions are very low and are not likely to cause any interference in nearby electronic equipment.
RF emissions CISPR 11	Class B: ***Veris*** 8600	The system is suitable for use in all establishments, including domestic establishments and those directly connected to the public low-voltage power supply network that supplies buildings used for domestic purposes.
Harmonic emissions IEC 61000-3-2	Class B: ***Veris*** 8600	
Voltage fluctuations/flicker emissions IEC 61000-3-3	Complies	

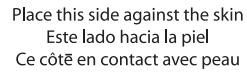
Guidance and manufacturer's declaration - electromagnetic immunity			
The system is intended for use in the electromagnetic environment specified below. The customer or user of the system should assure that it is used in such an environment.			
Immunity test	**IEC 60601 test level**	**Compliance level**	**Electromagnetic environment - guidance**
Electrostatic discharge (ESD) IEC 61000-4-2	+6 kV contact +8 kV air	+6 kV contact +8 kV air	Floors should be wood, concrete or ceramic tile. If floors are covered with a synthetic material, the relative humidity should be at least 30%.
Electrical/fast transient/burst IEC 61000-4-4	+2 kV for power supply lines +1 kV for input/output lines	+2 kV for power supply lines +1 kV for input/output lines	Mains power quality should be that of a typical commercial or hospital environment.
Surge IEC 61000-4-5	+1 kV differential mode +2 kV common mode	+1 kV differential mode +2 kV common mode	Mains power quality should be that of a typical commercial or hospital environment.
Voltage dips, short interruptions and voltage variations on power supply input lines IEC 61000-4-11	<5% U_T (>95% dip in U_T) for 0.5 cycle 40% U_T (60% dip in U_T) for 5 cycles 70% U_T (30% dip in U_T) for 25 cycles <5% U_T (>95% dip in U_T) for 5 sec	<5% U_T (>95% dip in U_T) for 0.5 cycle 40% U_T (60% dip in U_T) for 5 cycles 70% U_T (30% dip in U_T) for 25 cycles <5% U_T (>95% dip in U_T) for 5 sec	Mains power quality should be that of a typical commercial or hospital environment. If the user of the system requires continuous operation during power mains interruptions, it is recommended the system be powered from an uninterruptible power supply or battery.
Power frequency (50/60 Hz) magnetic field IEC 61000-4-8	3 A/m	3 A/m	Power frequency magnetic fields should be at levels characteristic of a typical location in a typical commercial or hospital environment.
NOTE U_T is the A.C. mains voltage prior to application of the test level.			

Guidance and manufacturer's declaration - electromagnetic immunity			
The system is intended for use in the electromagnetic environment specified below. The customer or user of the system should assure that it is used in such an environment.			
Immunity test	**IEC 60601 test level**	**Compliance level**	**Electromagnetic environment - guidance**
Conducted RF IEC-61000-4-6 Radiated RF IEC 61000-4-3	3 V rms 150 kHz to 80 MHz 3 V/m 80 MHz to 2.5 GHz	3 V rms 3 V/m	Portable and mobile RF communications equipment should be used no closer to any part of the system, including cables, than the recommended separation distance calculated from the equation applicable to the frequency of the transmitter. **Recommended separation distance:** $d = 1.17 \sqrt{p}$ $d = 1.17 \sqrt{p}$ 80 MHz to 800 MHz $d = 2.33 \sqrt{p}$ 800 MHz to 2.5 GHz Where p is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer and d is the recommended separation distance in meters (m). Field strengths from fixed RF transmitters, as determined by an electromagnetic site survey,[a] should be less than the compliance level in each frequency range.[b] Interference may occur in the vicinity of equipment marked with the following symbol:
NOTE 1 At 80 MHz and 800 MHz, the higher frequency range applies. **NOTE 2** These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects and people.			
[a] Field strengths from fixed transmitters, such as base stations for radio (cellular/cordless) telephones and land mobile radios, amateur radio, AM and FM radio broadcast cannot be predicted theoretically with accuracy. To assess the electromagnetic environment due to fixed RF transmitters, an electromagnetic site survey should be considered. If the measured field strength in the location in which the system is used exceeds the applicable RF compliance level above, the system should be observed to verify normal operation. If abnormal performance is observed, additional measures may be necessary, such as reorienting or relocating the system. [b] Over the frequency range 150 kHz to 80 MHz, field strengths should be less than 3 V/m.			

Symbols and Descriptions	Symbol	Definition
Regulatory Symbols		European Community Mark
		ETL Mark
		FCC (US Federal Communications Commission) Mark
Safety Symbols		ATTENTION! Refer to Operation Manual for Information
		Shock Hazard
		Type CF Equipment, defib proof
	IPX0	Indicates no protection against ingress of water (remote display)
	IPX1	Identifies the degree of protection against fluid as drip-proof (main monitor)
	IPX2	Identifies the degree of protection against fluid as drip-proof (power supply)
		Equipotential Terminal
		Ground Symbol
		Indicates the MR magnet and power
		Indicates distance between MR magnet and monitor
		Indicates the presence of a battery
		Recycle batteries following hospital protocols and local environmental regulations.
		Do not incinerate! Keep away from fire or other sources of extreme heat.

	Symbol	Definition
		Do not dispose of in municipal waste. Wheeled bin symbol indicates separate collection for electrical and electronic equipment. (WEEE Directive 2002/96/EEC)
		Risk of electrical shock! Do not remove cover. Refer servicing to qualified personnel.
System Symbols		Fuse
		Alternating Current (AC)
		Direct Current (DC)
		Wireless Product
Port Symbols		Signal Input
		Signal Output
	IOIOI	Digital Output
		Air Intake
		Scavenging Port
		Communication Port
		Video Out

Miscellaneous Symbols

Symbol	Definition
	Technical Support Phone Number
	Manufacturing Contact
	Serial Number
	Part Reference Number
	Place this side against the skin (Blood Pressure Cuff)
	Placement of the cuff over the brachial artery.
	Single use device only. Do not reuse.

Definition of Warnings and Cautions

Definitions for Warning, Caution, and Note symbols:

⚠**DANGER**⚠	Designates an imminent danger. Non-observance is likely to lead to death or the most severe injuries.
⚠**WARNING**⚠	Designates a possible dangerous situation. Non-observance may lead to death or the most severe injuries.
⚠**CAUTION**⚠	Designates a possible dangerous situation. Non-observance may lead to minor injuries or damage to the product.

NOTE: Indicates that important information follows, a tip that can help you recover from an error, or point you to related details in the manual.

Warnings

⚠**WARNING**⚠

- Read this manual entirely before using the monitor.
- Inspect For Damage! User should inspect the system for signs of damage. Do not use the system if failure is evident or suspected.
- Possible burn hazard! Do not coil cables inside the MR scanner.
- Possible explosion hazard! Do not use the monitor in the presence of flammable anesthetics. The equipment is not suitable for use in the presence of a flammable anesthetic mixture with air or with oxygen or Nitrous Oxide.
- Possible explosion hazard! Do not use the monitor in the presence of gas mixtures which may be flammable.
- Do not use this device in conjunction with flammable anesthetics such as cyclopropane and ether. The monitor can sample from pure oxygen environments, but the monitor itself should never be placed inside an oxygen tent or gas containment apparatus. Proper anesthetic gas waste recovery should be used. When not in operation, this device is not intended to be connected to any pressurized source containing an enriched oxygen environment.
- Cables, tubing, and lead wires may present a risk of entanglement or strangulation! Verify safe and proper positioning of these items at all times.
- Unapproved modifications to the monitor may cause unexpected results and present a hazard to the patient.

- Risk of electrical shock! Do not remove cover. Refer servicing to qualified personnel.

⚠WARNING⚠

- All cords must have hospital grade plugs and be plugged into hospital grade outlets. (The electrical installation of the relevant room must comply with NFPA 70: National Electric Code or NFPA 99: Standard for Health Care Facilities. Outside the United States, the relevant room must comply with all electrical installation regulations mandated by the local and regional bodies of government).
- Do not bring tools containing ferrous material into the magnet room. Risk of serious injury and/or damage to equipment can occur.
- Do not route gating cables near or within the scanning volume.
- Apply brakes to prevent movement.
- Improper disposal of batteries may result in explosion, leakage, or personal injury. Do not open batteries. Do not dispose of batteries in a fire. Follow all local regulations concerning the disposal of spent Lead-acid and Lithium-Ion batteries or contact MEDRAD for assistance.
- Connect only MEDRAD approved three-lead or five-lead ECG cables from the patient to the ECG module. Do not connect any other signal source to the ECG module.
- There is no defibrillator synchronization output on the ***Veris*** monitor. Make no connections between the ***Veris*** and a defibrillator.
- Leakage currents may increase if other equipment is interconnected to the patient. The increased leakage currents may present a hazard to the patient.
- PACEMAKER PATIENTS: This device does not include pacemaker spike rejection capability. Heart rate readouts derived from the ECG patient connections are likely to display erroneous high or erratic rates when a pacemaker is in use. Keep pacemaker patients under close surveillance. For pacemaker patients it may be advisable to select the SpO_2 function as the primary heart rate source.
- High Frequency (HF) surgical equipment may affect ECG operation. The system is not designed to operate in the presence of ESU interference. The patient may be burned. Patient burns can also result from a defective HF surgical equipment neutral electrode connection.
- The heart rate calculated by the monitor may be affected by cardiac arrhythmia.
- Do not stand on power supply enclosure. Injury from tripping or falling can occur.

⚠WARNING⚠

- Do not stand on the base. Possible injury can result from falling.
- Do not take the remote display or the ECG module battery charger into the MR scanner room. These contain ferromagnetic material and can be strongly attracted to the magnet causing a safety hazard.
- Do not use with an open MRI. Use of the monitor in an open MRI may result in erratic or unavailable monitoring.
- Do not stand or sit on monitor accessories tray. Possible injury can result from falling.
- Do not stand or sit on monitor accessories tray. Possible injury can result from falling.
- U.S. Federal law restricts this device to sale by or on the order of a physician.

Cautions

⚠CAUTION⚠

- Use only accessories designated for use with this monitor. Use of accessories not designated for use with the ***Veris*** monitor can cause inaccurate measurements and/or a safety hazard for the patient.
- This device has been tested to 60601-1-2 specified levels for emissions of and immunity to electrical interference. External disturbances which exceed these levels may cause operational issues with this device. Other devices which are sensitive to a lower level of emissions than those allowed by IEC 60601-1-2 may experience operational issues when used in proximity to this device.
- Equipment accuracy may be affected at extreme temperatures.
- Do not store equipment at extreme temperature. Temperatures exceeding specified storage temperatures could damage the system.
- Avoid routing the DC cable through the magnet room door. Possible damage can occur to the DC cable and/or the scanner room door.
- Do not press on the keys with sharp or hard objects. This could damage the keys. Use only your fingertips to press on the keys.
- Changes or modifications not expressly approved by MEDRAD, Inc., may void the user's authority to operate the equipment and may also void the warranty.
- Do not use the monitor in the path of a Linear Accelerator or Positron Emission Tomography (PET) scanner beam. This could result in inaccurate physiologic parameters or waveforms.

⚠CAUTION⚠

- Transporting the monitor in a mobile scanner trailer can lead to damage from shock, vibration, or extreme temperatures.
- Do not allow the conductive parts of the patient electrodes to contact other conductive parts, including ground (earth).
- High Frequency (HF) surgical equipment may affect ECG operation.
- Do not tip the monitor. Possible injury can result from falling.
- Do not pinch cables between the table and the bore. This can damage the cables.
- Do not roll the monitor over or step on cables. This can damage the cables.
- Do not bend fiber optic cables too tightly. Refer to the specifications in Appendix C of the *Operation Manual*.
- If a probe falls on the floor or into liquid, clean the probe following proper cleaning methods. If the probe is not properly cleaned, inaccurate physiologic parameters or waveforms may result.
- Do not place more than 40 pounds (18 kg) on the tray.

Leakage Current

The monitor complies with leakage current limits required by medical safety standards for patient-connected devices. The ***Veris*** monitor conforms to EN 60601-1 standards. A hazard caused by the summation of leakage currents is possible, when several pieces of equipment are interconnected.

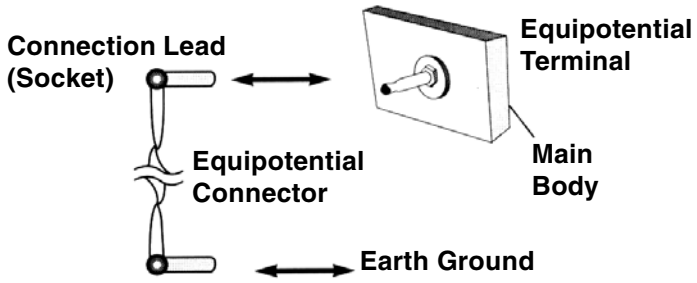
Voltage Fluctuations

When operated in the line voltage range specified in this manual any minor fluctuations will have a negligible effect. Very low line voltage will cause the monitor to revert to battery power. Very high line voltage may cause damage to the charger circuits. The monitor is designed with circuitry that will turn the unit off before spurious readings can be caused by a low battery condition.

Equipotential Ground

Health care providers and patients are subject to dangerous, uncontrollable compensating currents for electrical equipment. These currents are due to the potential differences between connected equipment and touchable conducting parts as found in medical rooms.

The safety solution to the problem is accomplished with consistent equipotential bonding. The remote display and the main monitor power supply are fitted with connecting leads made up with angled sockets to the equipotential bonding network in medical rooms.



Software Version

The initial release of this monitoring system was at a software revision of 1.0 on the main monitor and 1.0 on the remote display on 4 January 2005. This revision could be advanced for many reasons following the initial release. To identify the presently installed revision on either the main monitor or remote display, power-up the monitor while observing the initial power-on screen. The current software revision will be displayed prior to display of the normal monitoring screen.

Software Error Related Hazard Mediation

MEDRAD, Inc., has quality control practices and procedures in place to review potential hazards as they relate to software. The monitor utilizes a four-digit year for all date, time, and leap year calculations.

Potential Interference

MAGNETIC FIELDS

Always position the ***Veris*** Base, Base Plus, and Cardiac monitors at or outside the 2000 Gauss line. Always position the ***Veris*** Anesthesia monitor at or outside of the 500 Gauss line. This monitor is designed specifically for MR compatibility and is 0.5 to 3T compatible. It will not cause interference with MRI image quality, nor will its performance be affected by the magnet field.

The "T" wave may become excessively large or inverted with the patient in the magnetic field. This effect is due to hemodynamic flow induced voltage and may interfere with QRS detection. Try other leads and/or electrode placements for best results.

CONDUCTED TRANSIENTS

The monitor conforms with IEC 61000-4-4, and IEC 61000-4-5 for conducted transients, and will operate with negligible adverse effects.

X-RAY, CT, ULTRASOUND, AND/OR NUCLEAR MEDICINE

The monitor will operate with negligible adverse effects in these environments. However, the monitor should not be placed directly in the radiated beam, which could damage the internal electronics of the monitor.

OTHER INTERFERENCE
There is a negligible adverse effect to the monitor from electrocautery and electrosurgery, infrared energy, and defibrillation.

CABLING INTERFERENCE
Route all ***Veris*** system cabling away from other manufacturer cables in the magnet room.

Biocompatibility

All patient-contact or user-contact materials in this monitor and it's accessories have passed ISO 10993-5, -10, & -11 biocompatibility tests or have been in use in clinical environments in large numbers over an extended period of time predating these standards.

Probes Fall in Fluids

Whenever probes fall and land in fluids, clean the probes according to the cleaning instructions in “Cleaning and Disinfecting” in Appendix A of the *Operation Manual*.

FCC and Industry Canada Compliance

This device complies with Part 15 of the FCC Rules.

Operation is subject to the following two conditions:

1. This device may not cause harmful interference, and
2. This device must accept any interference received, including intereference that may cause undesired operation.

⚠WARNING⚠

- Changes or modifications not expressly approved by the party responsible for compliance could void the user’s authority to operate the equipment.

The term “IC” before the certification/registration number only signifies that the Industry Canada technical specifications were met.

IC: 5338A-CSI8600

Audible Pulse Tone

The amplitude of the audible pulse tone remains constant regardless of changes in patient parameter measurements.

Accessory Disposal

Discard disposable medical waste according to your institution's policies and procedures to prevent biological contamination. See “Disposal” in Appendix A of the *Operation Manual*.

Latex Content

This MEDRAD product (patient monitors and approved accessories) are free from latex in any location that may result in patient contact.

2 *Main Monitor Maintenance and Checkout*

This section contains recommended procedures for maintenance, and an operational checkout of the MEDRAD ***Veris*** patient monitor. Routine maintenance and inspection will:

- Ensure continued performance of the patient monitor system.
- Reduce the possibility of equipment malfunction.

Incoming Inspection

You must inspect patient monitors coming back from service for shipping damage before you place them into operation just like newly purchased patient monitors. The patient monitor should be free from dents, cracks, or other physical damage.

If further incoming inspection or testing is required, the manufacturer recommends that you use the Alarms Verification (located in this section) as an incoming inspection test. You can perform additional electrical safety testing in this section as part of an incoming inspection in accordance with the policies of the health care provider.

Maintenance Schedule

Every Patient	• Clean and disinfect the sensor cables and sensor. • Inspect the accessories and cables for damage. • Change the gas sampling device and sampling line. • Check the NIBP function. • Change the water trap
Every Day	• Charge the batteries as necessary. If not using the monitor on a patient, keep it plugged into the power supply for continuous charging. • Test the NIBP function.
Every Week	• Charge the ECG module battery.
Every 3 Months	• Clean the exterior of the unit (or clean as needed). • Fully charge the batteries.
Every Year	• Perform the annual safety tests. • NIBP calibration and safety tests. • Verify the CO_2 and agent gas calibration.

MEDRAD also recommends that a complete system calibration and performance checkout be performed annually. Contact MEDRAD Factory Service or your local MEDRAD office for complete details.

In the United States, Canada, Japan, and Europe, the MEDRAD Service Department offers Preventive Maintenance Programs. These annual programs greatly assist in maintaining accuracy and reliability, and can also extend the life of the system. COntact MEDRAD for details. In Europe, contact your local MEDRAD office or your local authorized dealer for further information. Refer to “MEDRAD Subsidiaries” on page 1-1 and “International Offices” on page 1-2 for address, telephone, and FAX information.

NOTE: Failures which occur due to a lack of proper maintenance will not be covered under warranty.

Monitor Safety Testing

You can perform the following tests as part of a periodic safety check. If the monitor fails any portion of these tests, contact MEDRAD.

The contents of this section include the following verifications and safety tests:

- Electrical Leakage
- Interface Inspection
- Manual Controls Check
- Alarm Verification
- Vital Sign Modules Verification
- ECG
- SpO_2
- NIBP
- IBP
- Temperature
- Gas Flow/CO_2/O_2
- Communications

Repaired modules could require more extensive testing than what is shown in this list.

Always follow ESD precautions when performing a procedure discussed in this section.

⚠WARNING⚠

- Because test procedures require working with exposed electrical circuits, only experienced electrical or biomedical technicians should perform the procedures.
- After a monitor is altered through repair or hardware adjustment, you must fully test it before use.

Equipment and Tools

The following procedures assume that the technician has an ESD safe workbench, a set of electronic hand tools, and a digital multimeter with a 10 amp setting. At the beginning of each test, special equipment can be listed. A variety of customized cables, clips, and test fixtures are also needed to complete the tests. For more information, contact MEDRAD.

Accessory Testing

Check the electrical safety of the power cord as part of the patient monitor safety testing.

Cleaning and Disinfecting

⚠WARNING⚠

- Shock Hazard! Before cleaning the patient monitor, turn the power off and disconnect the AC power cable.
- Shock Hazard! Never immerse the patient monitor because the patient monitor has an internal power source that is active even when the unit is unplugged.

Do not use abrasive cleaners on the patient monitor or on any sensors or probes. Abrasive cleaners damage the patient monitor.

With the exception of the display screen, wipe clean the exterior surface of the patient monitor with alcohol. Dry it with a soft, dry cloth. Because paper towels or tissues can scratch the surface of the display, use a cotton cloth to clean the patient monitor.

Do not use full-strength alcohol on the display screen. Repeated use of strong cleaners damages the screen. Clean the display window by wiping it clean with a soft, lint-free cloth sprayed with common glass cleaner, however, do not spray glass cleaner directly on the display.

Accidental Wetting

⚠WARNING⚠

- Shock Hazard! Because a patient monitor is an AC-powered device, an immersed patient monitor presents a danger to anyone who attempts to handle the device.

Immediately perform the following steps following an accidental wetting of equipment:

1. Turn the power off. Disconnect AC power from the patient monitor.
2. If the monitor is monitoring a patient, transfer the patient to another monitor as quickly as possible.
3. Use a clean, dry towel or cloth to remove the liquid from the patient monitor housing.
4. A service technician should inspect the patient monitor as soon as possible.
5. If the internal mechanism is saturated, allow the liquid to drain out for 24 hours before shipping.
6. If liquid has entered the patient monitor, it must be dried and cleaned internally. Full testing is required before you can use the monitor. Contact MEDRAD as soon as possible.

Time is critical. The longer any liquid remains in the patient monitor, the more damage it can do. It is important to service the patient monitor immediately after any liquid is spilled into it.

Battery Safety

The batteries require no maintenance. For more information, refer to the *MEDRAD **Veris** 8600 Patient Monitor Operator's Manual*.

⚠CAUTION⚠

- Do not short circuit the battery terminals! The resulting high-current discharge can cause burns.
- Charge the battery completely after extended battery use to ensure a fully-charged battery is available for the next use.
- Explosion hazard! Keep lighted cigarettes, sparks, and flames away from the battery.
- The battery contains sulfuric acid electrolyte that can cause severe burns and eye damage, as well as illness from sulfur oxide fumes.
- Do not crack, cut, burn, or dissolve (with solvents) the battery case. Damaging the battery case can cause the release of sulfuric acid. If sulfuric acid is released from the battery, wear eye protection and rubber gloves to handle the battery, and use a solution of baking soda in water to neutralize the sulfuric acid.
- Do not incinerate the batttery. The used battery is a potential environmental hazard and must be disposed of properly. Dispose of the old battery in accordance with local and federal laws.

Long-Term Monitor and Battery Storage

No special preparation is necessary for long term storage of the monitor. Although you do not have to remove the battery from the monitor for long term storage, the battery drains to an unrecoverable state after 3 months without periodic charging.

Monitor and Accessories Disposal

At the end of its useful life, you can dispose of the monitor and its accessories according to your institution's policies and procedures for disposal of patient-contact medical waste.

Alternately, you can return the monitor and its accessories to MEDRAD, Inc., for safe disposal. The shipping address is:

MEDRAD, Inc.
One Medrad Drive
Indianola, PA 15051-0780 USA

Fuse Replacement

There are two AC power fuses located at the AC input side of the power supply directly above the AC power entry socket. See the fuse specifications for the proper fuse.

1. Pry the cover from the fuse well above the AC cord.
2. Gently remove the fuse assembly and remove the spent fuse(s).
3. Replace fuses and reassemble in reverse order.

Electrical Safety Testing (Main Monitor)

Perform this test each time you open the patient monitor housing and before you use the monitor on patients.

⚠WARNING⚠

- Shock Hazard! Because dangerous and lethal voltages are present during the withstanding voltage, leakage, and ground continuity test, all leakage and voltage testing must be done with the monitor housing in place. For complete information about the proper operating and safety procedures, refer to the ***Veris*** *8600 Patient Monitor Operator's Manual.*

Leakage Test Equipment and Setup

Perform all testing with the cover on. The following test requires a Dynatech 232D leakage tester or equivalent.

1. Perform a self-test, if applicable, on the DYNATECH 232D by plugging it into 110 VAC outlet. Turn on the leakage tester. Set the mode switch to self test. Display should read 1000 ±20 and the *CURRENT SOURCE ACTIVE* lamp should be on.

⚠CAUTION⚠

- If these conditions are not met, do not continue with this test.

2. Set the mode switch on the Dynatech 232 to L1-L2 (line voltage). The display should read the line voltage ±10%. Set the mode switch to L1-GND. The display should read no more than 5% of L1-L2 on a grounded power system. Set the mode switch to L2-GND.

   NOTE: This should read about the same as the L1-L2 reading for a grounded system.

Leakage Test Procedure

The monitor must be powered up during all of the isolation tests.

1. Turn the mode switch to EARTH CURRENT LEAKAGE. Connect the AC cord from the Dynatech 232D to the monitor, and turn on the unit. With the POLARITY switch in the NORMAL position, press OPEN GROUND and monitor the readout for less than 0.25 mA at 120VAC.
2. Change the polarity switch to the REVERSE position, press OPEN GROUND and monitor the meter for less than 0.25 mA at 120VAC.
3. With the POLARITY switch in the NORMAL position, press OPEN NEUTRAL and OPEN GROUND switches and monitor the meter for less 0.25 mA at 120VAC.
4. Change the POLARITY switch to the REVERSE position and press the OPEN NEUTRAL and OPEN GROUND switches and monitor the meter for less than 0.25 mA at 120VAC.
5. *Cardiac and Anesthetic models only:* Connect an IBP ground leakage cable to a brown lead of the leakage tester. Turn the LEADS selector switch to the ISO position. Turn the POLARITY switch to NORMAL, press the ISO TEST button, and monitor the meter for less than 20 microamps. Verify IBP current leakage is less than 0.020mA.

Functional Testing

Interface Inspection

This procedure is for the monitor's TFT active display.

1. Verify that a readable screen displays. For a guide to proper screen layout, refer to the ***Veris*** *8600 Patient Monitor Operator's Manual* for sample screens.
2. Verify that the screen display is clear and bright when you directly face the patient monitor.
3. Verify the image quality. There should be no intermittence or jittering of pixels. The maximum amount of pixels missing from any display are as follows:
   - Maximum number of bad dots allowed per screen is 7.
   - Maximum number of bad dots within any 20mm radius circle is 1.

Manual Controls Check

1. Verify that rotating the menu knob moves the cursor through the menu items. Verify that when you press the menu knob on a highlighted menu item the monitor displays a sub-menu.
2. Use the menu knob to enter the *CONFIG* window and set the date and time for the real time clock.
3. Press the FREEZE key. Verify that you get an audible response from the speaker. Press the FREEZE key again to unlock the waveforms.
4. Press the TREND key. Verify that you get an audible response from the speaker. A *Trend* window appears on the display. Press the TREND key again to close the *Trend* window. (Or optionally, press and hold the TREND key to open the *TYPE/INTERVAL/ SCREEN* menu that you close by selecting *EXIT*.)
5. Press the STAND BY key. Verify that you get an audible response from the speaker. A standby confirmation menu or *ALARM STANDBY MODE* message should appear. Press the STAND BY key again to return to the screen.
6. Press the DEFAULT key. Verify that you get an audible response from the speaker. The *Custom Default* menu appears. Select *NO* and then select *EXIT* to return to the *Main* window.
7. Press the NIBP CYCLE/STAT key. Verify an audible response from the speaker. The *NIBP STAT/Cycle Time* menu appears. Choose *EXIT* to return to the *Main* window.
8. Press the NIBP key. Verify an audible response from the speaker and that the NIBP pump runs. Press the NIBP key again to cancel the reading.
9. Press the PRINT key. Verify an audible response from the speaker.

   NOTE: Since no printer is present, nothing should happen. The audible response verifies that the key is functional.
10. Press the SILENCE Key. Verify an audible response from the speaker and that a silence symbol appears in the top, right hand corner of *Waveform 1*.

Fiber Optic Communication

This test is for units with a remote display. If the ***Veris*** patient monitor does not have a remote display, skip this test.

To verify fiber optic communication:

1. Enter the *CONFIG* menu and select *ENTER NETWORK CONFIG*.
2. Enter the password (MEDRAD) to enter, then click on *Yes*.
3. Set to the following:
   - Sync Type: Fiber Optic
   - IP Address: 192.168.000.*xxx*
   - Net Mask: 255.255.255.000
   - Port: 02571
   - Channel Type: Peer-to-Peer
   - Channel: X
   - SSID: Any
4. Select *Exit* to effect changes.
5. Re-cycle the power to save the setting.
6. Turn on a test ***Veris*** remote display set to *Fiber Optic*. Verify communication.
7. Use the encoder to verify that the screen on the remote display replicates what is present on the main monitor.
8. Press the PRINT key on the main monitor and verify that the remote display prints data.

Alarms Verification

To verify the alarm circuitry for SpO_2, perform the following procedure.

1. In the *PARAMS* window turn off all monitoring modules except for SpO_2. Set the display to show a plethysmograph waveform.
2. In the *PARAMS* window set the *SpO2 Low Limit Alarm* setting to *HIGH*. This sets the alarm priority for only this alarm parameter.
3. Use an SpO_2 simulator to set the monitor to display the plethysmograph waveform. Confirm the heart rate reading appears in the HR parameter box and the saturation reading appears in the SpO_2 parameter box.
4. In the *ALARMS* window adjust the SpO_2 low alarm level above the saturation reading to cause an alarm condition.
5. Verify that the message *LOW SPO2* appears at the top of the waveform channel in red letters.
6. Verify that you get an audible response. The alarm should be a high priority alarm tone consisting of 3 beeps followed shortly by two beeps.
7. In the *PARAMS* softkey window, change the *SpO2 Low Limit Alarm* setting to *MEDIUM*.
8. Verify that the message *LOW SPO2* appears at the top of the waveform channel in yellow letters.
9. Verify that you get an audible response. The alarm should be a medium priority alarm tone consisting of 3 beeps.

ALARM VOLUME TEST

1. From the *ALARMS* window, vary the *Alarm Volume* through the ranges, from *1* to *10*. Verify that the speaker volume changes according to the setting of the *Alarm Volume*.
2. Press the alarm SILENCE key once. Verify that the low heart rate alarm stops for 2 minutes and that the 2-minute *Alarm Silence* symbol appears in the top, right hand corner of Waveform 1.
3. Press and hold the alarm SILENCE key for at least 2 seconds. Verify that the low heart rate alarm stops and the infinity *Alarm Silence* symbol appears in the top, right hand corner of Waveform 1.

Module Verification

NIBP Verification

The NIBP verification requires Dynatech Nevada NIBP Analyzer. Connect the 8600 monitor to a Dynatech Nevada NIBP Analyzer set for the following operation.

NIBP Analyzer Settings
Adult 120/80 (90); Heart Rate 80 bpm
Neonate 80/50 (62); Heart Rate 80 bpm
Pressure Adjustments: Gain 100%; Shift 4

1. Use the T-connection with a small adult or adult cuff for these tests. Wrap the cuff around the monitor's pole. Connect the cuffs to the 0-300 mmHg port of the NIBP analyzer.
2. Connect the monitor to an AC (mains) power source and turn on the monitor.
3. Press and hold down the monitor's NIBP CYCLE/STAT key. The monitor's cycle time window appears.
4. Select the *NIBP Cycle Time* to two minutes.

120/80 OPERATION SETTING

1. In the monitor's *ADM/DIS* window set the *Patient Size* to *Adult* mode.
2. Connect the NIBP hose to the fitting on the monitor.
3. Press the NIBP key.
4. Allow the monitor to take at least four (4) readings. Calculate the average of the four (4) readings and verify that each reading does not vary by more than ±4% or ±4mmHg (whichever is greater) from the calculated average. Each reading shall not vary more than 8 mmHg from the simulator setting.
5. Recalibrate the monitor if necessary.

80/50 OPERATION SETTING

1. Set the monitor to the *Neonate* mode. Use a Neonate cuff wrapped around a post on the tray.
2. To verify *STAT* mode operation, press and hold the NIBP CYCLE/STAT key.
3. Allow the monitor to take at least four (4) readings. Calculate the average of the 4 readings and verify that each reading does not vary by more than ±4% or ±4mmHg (whichever is greater) from the calculated average. Each reading shall not vary more than 8 mmHg from the simulator setting.

SpO_2 Verification

The following test requires a SmartSat SpO_2 analyzer and an 8-pin serial test connector with a BNC connection at one end.

1. Verify that the message *SPO2: NO SENSOR* appears when there is nothing connected to the SPO2 connector.
2. Verify that the message *SPO2: SENSOR* appears when you plug the finger sensor in, but without a finger actually inserted into the sensor.
3. Verify that the message *SPO2: HIGH AMBIENT* appears by introducing a higher than normal amount of ambient light on the SpO_2 sensor detector. Verify the message disappears within 10 seconds after you remove the ambient light.
4. Place the SpO_2 finger sensor on an index finger and verify that the heart rate and plethysmograph operation display on the LEDs within 15 seconds. Verify that SpO_2 error messages do not appear (alarm violations can occur depending on individual readings and monitor set-up).
5. Select *Pleth* in a waveform setting in the *DISPLAY* menu. Verify the LCD displays a plethysmograph waveform. Connect the 8-pin serial test cable to the monitor: the 8-pin connector to COM2 on the monitor and the BNC connector into an oscilloscope channel. In the *CONFIG* window, scroll to *ANALOG OUT SELECT*, then select *PLETH*. Use the SpO_2 finger sensor to verify that the SpO_2 waveforms appear on the scope. The waveform should be centered on 0 volts and register 1 volt peak-to-peak. Remove the SpO_2 cable.
6. Verify that the pulse tone increases as you change the tone from *1* to *10* in the *Alarm Setting* window.
7. Use an optical load to simulate a small signal and verify that the message *SPO2: SEARCH or LOST* appears after search delay time ± 5 seconds. (An optical load that can be used for this test is a foam peanut used for packing.)
8. Enter the *DISPLAY* screen and change the SpO_2 waveform size to *x2* and *x4* and verify the scale change on the display for each setting. Return size setting to *x1*.
9. Connect a Smart Sat SpO_2 simulator and verify the readings are within the acceptable tolerance found in the “Smart Sat Procedure” on page 2-11.

Smart Sat Procedure

Equipment needed:

- SmartSat SS-100A or equivalent pulse oximetry analyzer

1. Turn on the pulse oximetry analyzer. Press F1 (Sp02 Sim) and then F2 (AutoSeq) to access the Programmable AutoSequence Directory.
2. Press F1 (Select↑) or F2 (Select↓) to select the file “CSI 1”. When the file has been selected press F5 (Run) to begin the program.
3. Insert the SpO_2 cable from the pulse oximetry analyzer in to the unit to be tested.
4. Turn on the monitor to be tested. Press F1 (Start) on the pulse oximetry analyzer to begin the simulation.
5. Verify the monitor stabilizes within the limits given for each level. Use Smart Sat Auto Sequence “CSI 1”.

Level	**SpO_2**	**Limits**	**Heart rate**	**Limits**
1	99%	97 - 99%	40 bpm	39-41 bpm
2	96	94 – 98	60	59-61
3	90	88 – 92	80	79-81
4	78	76 – 80	100	99-101
5	61	58 – 64	120	119-121
6	52	49 – 55	180	179-181
7	40	37 – 43	300	297-303

6. If the ***Veris*** monitor fails only 1 level, rerun that level using the manual mode of the pulse oximetry analyzer.
   a. Press PREV (2) times and then F1 (Manual).
   b. Press F4 (Change+), and F5 (Change-) to manually set the SPO2 %.
   c. Press F3 (-->Select) to select pulse rate. Press F4 (Change+), and F5 (Change-) to manually set the PULSE RATE (BPM).
   d. Allow 30 seconds for the readings to settle. If the readings settle within the given limits, pass the monitor.

SpO_2 Gating Verification

1. Connect a gating test cable to the GATING connector on the monitor.
2. Enter the *PARAMS* menu and set *Gating* to *SpO2 Pulse*.
3. Verify that the gating output matches the heart rate frequency.

ECG Verification

This test requires a Dynatech Nevada Model 300 simulator.

NOTE: For Base and BasePlus models, begin with step 5.

1. Select the *PARAMS* menu to set up for *ECG PARAMS* to *5-Lead, ECG ON*, Filters: *MONITOR, SENSITIVITY* to *HIGH*.
2. Insert a shorted ECG cable into the ECG connector. Use the menu knob to enter the *DISPLAY* window. Set the following and use the current defaults for the size. They are 25MM except waveform 1:
   - Waveform 1 ECG I x 4.0 25.0
   - Waveform 2 ECG II x 4.0 25.0
   - Waveform 3 ECG V x 4.0 25.0
3. Exit the *DISPLAY* window. Verify that the baselines are centered. Verify that the base line signal is no greater than 3 pixels in height. Select the most solid line as the reference line and verify that this reference is less than ±3 pixels from the ECG y-axis center line. Remove the shorted cable.
4. Verify that the message *LEADS OFF* appears at the top of the window when a cable is not connected.
5. Connect the 3-lead ECG patient cable to the ECG cable assembly, and use a Dynatech Nevada Model 300 simulator to turn on (ECG) normal sinus, 60BPM, amp 1.0mV, axis int. Respiration rate 20, and the impedance set for 0.5 ohms, and base impedance for 2K. Set the “Lead select” on the simulator to Lead II.
6. Rotate the menu knob to select *PARAMS* and press to enable the menu. Select for *ECG Cable: 3 lead*). Set the monitor for *LEAD II* waveforms. Check the following lead configurations for the following items:
   - Heart rate 60 ±3 BPM,
   - *RESPIRATION RATE* of 20 ±2 breaths per minute and
   - Correct waveform.

7. Use the Electrode status error messages on the monitor display to perform a lead off check in LEAD II.

(LL) Red	LEAD OFF
(LA) Black	LA LEADS OFF
(RA) White	RA LEAD OFF

   NOTE: This completes the ECG Verification for Base and BasePlus models. Continue with the Electrical Safety tests.

8. Connect all the leads back on the simulator and select *ECG Cable* to *5-lead*. Set the monitor for LEAD I waveforms. Verify that the following messages appear and lead switching occurs as each lead is disconnected one at a time (reconnect the cable to eliminate the message and return the waveform):

(V1) Brown	V LEADS OFF	
(LL) Red	LEADS OFF	
(LA) Black	LA LEAD OFF	LEADSWITCH TO LEAD II
(RA) White	RA LEAD OFF	LEADSWITCH TO LEAD III

   NOTE: The Green lead (RL) does not display a lead off message. Verification is not required.

9. Check the following lead configurations for following items:
   - Heart rate 60 ±3 BPM,
   - Correct waveforms.

10. Set the Dynatech MED SIM300 to a heart rate of 300BPM. Verify that the ECG HR reads *300BPM ±1BPM*.
11. Turn off the simulator and verify that the message *ECG LOST* appears at the top of the window.
12. Turn the simulator back on and set the simulator for 60BPM, LEAD II and verify that the gain settings are effective at x.5, x2, and x4 for 1mv ECG input.
13. Select **ECG** on the simulator, select **base**, then **BPM**, and **60**. This gives a normal sinus rhythm at this time. Select **ECG**, then **ARRH**, then **VNT2**, and then **VFIB**. The unit should detect an erratic baseline and display the message *ECG LOST*.

ECG Gating Verification

1. Enter the *PARAMS* menu and set *Gating* to *ECG Pulse*.
2. Set the ECG simulator to normal sinus and heart rate to 60bpm. Connect a modified gating cable from the GATING connector on the monitor to an oscilloscope and verify that the frequency of the output matches the input BPM.

IBP Verification

The main focus of the following steps is the MED SIM 300 (or its equivalent). This is only for monitors with IBP (Cardiac and Anesthetic models).

1. Attach the IBP cable from **BP1** on the simulator to **IBP 1** on the monitor's connector panel.
2. Select BP on the simulator. Select **Channel 1**. Select **STAT** . Select **ZERO** by using the up and down arrows on the MED SIM 300, scroll through the menu until *STAT* appears and press to select.
3. Rotate the rotary encoder knob to highlight *PARAMS* and move down to *IBP1*. Press the menu knob once. Set the *SITE* for *ART*.
4. Press the rotary encoder knob again. Adjust the *RANGE*. This should be set for *0-200*. Press the rotary knob until you reach *IBP1* again.
5. Exit out of *PARAMS*. Use the rotary encoder knob to scroll to select the *IBP1 ZERO* selection on the display. Observe that a *0* (zero) appears on the screen next to the line that contains *ART (---/---(0) MMHG*.
6. Return to the Medsim and select *WAVE* and execute. Select *ART* for *ARTERIAL* and press *EXE* to execute the function. Observe the waveform on the screen. Verify that the pressure reads 120/80 ±2MMHG.
7. Attach the IBP cable from **BP2** on the simulator to **IBP 2** on the monitor's connector panel.
8. Select BP on the simulator. Select **Channel 1**. Select **STAT** . Select **ZERO** by using the up and down arrows on the MED SIM 300, scroll through the menu until *STAT* appears and press to select.
9. Rotate the rotary encoder knob to highlight *PARAMS* and move down to *IBP2*. Press the menu knob once. Set the *SITE* for *CVP*. Press the rotary encoder knob again. Adjust the *RANGE*. This should be set for *0-20*. Press the rotary knob until you reach *IBP2* again.
10. Exit out of *PARAMS*. Use the rotary encoder knob to scroll to select the *IBP2 ZERO* selection on the display. Observe that a *0* (zero) appears on the screen next to the line that contains *CVP (0) MMHG*.
11. Return to the Medsim and select *WAVE* and execute. Select *CVP* and press *EXE* to execute the function. Observe the waveform on the screen. Verify that the pressure reads 12 ±1MMHG.

Temperature Verification

1. Measure room air temperature using each probe (1 and 2) and compare the output with a calibrated thermocouple. Verify each reading is within 0.5°F of each other and the thermocouple.
2. Place each probe and the thermocouple probe between an index finger and a thumb. Verify each reading is within 0.5°F of each other and the thermocouple.

Anesthesia/CO_2/O_2 Verification

Turn on the monitor and then rotate the menu knob to select the *PARAMS* window. Go to *Other Params Menus* and select *Gas Menu*. Select the unit of measure for *PERCENT* under *CO2*.

PNEUMATIC LEAKAGE TEST

1. Power cycle the monitor. After the monitor has completed the auto-cal, connect a vacuum gauge to the sample line of the water trap. Verify that the vacuum at the sample line is greater than 10 inches of mercury within 30 seconds.

OCCLUSION TEST

1. With the vacuum gauge still attached, verify the *OCCLUSION* message appears on the screen and that the pump runs at a higher speed to clear the occlusion.

EXHAUST FLOW VERIFICATION

1. Verify that the exhaust flow is fluctuating approximately 100 mL/min – 200mL /Min.
2. Obstruct the exhaust port (pinch tubing or cover the port with a finger) and verify the *AGT: NO EXHAUST* message appears.

VERIFY EXPIRED O_2

1. Run 5% CO_2, 95%N_2 mixture connected via a breathing simulator to the sample line. Verify the expired O_2 is less than 1%.

NOTE: If any verification fails, contact MEDRAD service.

Electrical Safety Testing (Power Supply)

Perform this test each time you open the power supply housing.

⚠WARNING⚠

- Shock Hazard! Because dangerous and lethal voltages are present during the withstanding voltage, leakage, and ground continuity test, all leakage and voltage testing must be done with the monitor housing in place. For complete information about the proper operating and safety procedures, refer to the ***Veris*** *8600 Patient Monitor Operator's Manual.*

Verification of Fuses and Assembly

1. Using a small flat head screw driver, remove fuse drawer with a prying motion. Inspect the fuse rating on each fuse of the AC inlet. Replace if not specified rating (3.15A @ 250V).

Leakage Test Equipment and Setup

Perform all testing with the cover on. The following test requires a Dynatech 232D leakage tester or equivalent.

1. Perform a self-test, if applicable, on the DYNATECH 232D by plugging it into 110 VAC outlet. Turn on the leakage tester. Set the mode switch to self test. Display should read 1000 ±20 and the *CURRENT SOURCE ACTIVE* lamp should be on.

⚠CAUTION⚠

- If these conditions are not met, do not continue with this test.

2. Set the mode switch on the Dynatech 232 to **L1-L2** (line voltage). The display should read the line voltage ±10%. Set the mode switch to **L1-GND**. The display should read no more than 5% of **L1-L2** on a grounded power system. Set the mode switch to **L2-GND**.

   NOTE: This should read about the same as the **L1-L2** reading for a grounded system.

Leakage Test Procedure

The monitor must be powered up during all of the isolation tests.

1. Verify Normal Earth Leakage is <0.25 mA at 120VAC line voltage.
2. Verify Earth Leakage with Reverse Polarity is <0.5mA at 120VAC line voltage.
3. Verify Earth Leakage with Open Neutral is <0.5mA at 120VAC line voltage.
4. .Verify Earth Leakage with Reversed Polarity and Open Neutral is <0.5mA at 120 line voltage.
5. Verify Normal Enclosure Leakage is <0.05mA at 120VAC line voltage.
6. Verify Enclosure Leakage with Reversed Polarity is <0.25mA at 120VAC line voltage.
7. Verify Enclosure Leakage with Open Neutral is <0.25mA at 120VAC line voltage.

8. Verify Enclosure Leakage with Reversed Polarity and Open Neutral is <0.25mA at 120VAC line voltage.
9. Verify Enclosure Leakage with Open Earth Ground is <0.25mA at 120VAC line voltage.
10. Verify Enclosure Leakage with Reversed Polarity and Open Earth Ground is <0.25mA at 120VAC line voltage.

Output Verification

1. Apply 120VAC to the AC inlet using a standard AC power cord.
2. Measure at the DB-15 connector.
   a. Measure between pins 1 and 8. Verify that the voltage is 16.5VDC (±0.2VDC).
   b. Measure between pins 2 and 9. Verify that the voltage is 16.5VDC (±0.2VDC).
   c. Measure between pins 3 and 10. Verify that the voltage is 16.5VDC (±0.2VDC).

   NOTE: If 0V is the measured output, this would indicate an open wire or miswired connection.

ECG Module Verification

Equipment Needed

- 1 ECG patient simulator (Fluke 217A or equivalent)
- 1 5-Lead ECG Leadset (3010473)
- 1 ECG fiber optic cable (3005290)
- 1 Hi-Pot Tester
- 1 100K-Ohm resistor with 2 8x32 screws and nuts.

Verification of ECG Module Charger

1. Connect the ECG moldule to an ECG Module Charger and verify that the green LED flashes slowly with an approximately 50% duty cycle.
2. Turn on the ECG moldule and verify that the fiber optic transmitter lights for approximately 1 second.
3. Turn off the ECG module and disconnect it from the charger.

Risk Current Testing

1. Turn on the ECG module and record and verify the following voltages.

   NOTE: Verify that all switches not specified as positive are negative.

Positive	Tied to	Range
RA	LA, LL, V, RL	1.75 to 2.75mV
LA	RA, LL, V, RL	1.75 to 2.75mV
LL	RA, LA, V, RL	-5.50 to –7.50mV
V	RA, LA, LL, RL	1.75 to 2.75mV
RL	RA, LA, LL, V	-0.1 to 0.1mV

ECG Display Testing

1. Remove the ECG module safety tester and connect an ECG patient simulator by using the 5-Lead ECG Leadset.
2. Set the ECG patient simulator to the following settings: Normal rhythm, 60bpm, 1mV amplitude
3. Set the ***Veris*** monitor to display ECG Leads II, III, and V.
4. Confirm that all three leads display as described.

   NOTE: The ECG module needs to be on for this test.

   Verify that Lead II displays a waveform with normal rhythm at 60bpm.

   Verify that Lead III displays a waveform about 1/3 of the size of Lead II with a normal rhythm at 60bpm.

   Verify that Lead V displays a waveform with the opposite polarity of Lead II and a normal rhythm at 60bpm.

ECG Lead-Off Testing

1. Remove the LA connection from the ECG module.
   a. Verify that the message *ECG: LA LEAD OFF* appears.
   b. Verify that the Lead III and Lead V traces becomes flat.
   c. Verify that the Lead II trace is unaffected.
   d. Replace the LA connection.
2. Remove the RA connection from the ECG module.
   a. Verify that the message *ECG: RA LEAD OFF* appears.
   b. Verify that the Lead II and Lead V traces becomes flat.
   c. Verify that the Lead III trace is unaffected.
   d. Replace the RA connection.
3. Remove the V connection from the ECG module.
   a. Verify that the message *ECG: V LEAD OFF* appears.
   b. Verify that the Lead V trace becomes flat.
   c. Verify that the Lead II and Lead III traces are unaffected.
   d. Replace the V connection.
4. Remove the LL connection from the ECG module.
   a. Verify that the message *ECG: LEADS OFF* appears.
   b. Verify that all lead traces become flat.
   c. Replace the LL connection.
5. Remove all test connections from the ECG module.

3 *Main Monitor Troubleshooting*

This section lists the possible causes of monitor problems. Use this table and the drawings in Section 6 to identify and locate components that malfunction.

Symptom	Problem	Solution
Unit won't power up (On/Off LED is dark)	• Battery is dead	Recharge the battery
	• Main Board is disconnected	Reconnect DC power cable at PS2 on Main Board
	• Main Board fuse blown	Replace F3 on Main Board
	• Bad membrane	Replace the keypad membrane
Cannot activate hardkey function or turn on monitor with AC power (On/Off LED is green)	• Membrane panel is disconnected or loose	Reconnect ribbon cable to J7 on Main Board
	• Keypad membrane is bad	Replace keypad membrane panel
Display is blank or not readable	• Video screen cables to Main Board are disconnected or loose	Reconnect data and inverter cables to connectors on Main Board (J2, J3, J4, and/or J5)
	• Inverter not plugged in	Make sure all Inverter connections are secure.
	• Bad inverter	Replace the inverter
No sound from speaker	• Volume turned down	Set volume higher in *Configuration* window.
	• Main Board connection is disconnected or loose	Reconnect J20 on Main Board
	• Speaker wire broken at speaker terminals	Check speaker wires for breaks or bad crimp pins
Speaker scratchy or unclear	• Metal debris on speaker	Remove debris from speaker drum
	• Bad speaker	Replace speaker
COM 1 serial interface doesn't work	• Set to internal printer	Reset monitor to external printer
	• Incorrect or bad cable	Replace with correct serial cable
	• Setting mismatch	Reset baud rate and other settings
	• Connector is bad	Replace the Main Board
No ECG trace displays	• ECG module battery may not be charged.	Charge ECG module battery.
	• ECG Cable may be bad.	Replace with known good cable.
	• The connection between Main Board J17 and VSM Board P1 is loose or disconnected.	Reseat the connection.
	• Fiber optic cable from ECG Gating Board may be loose or disconnected.	Reseat the connection.
	• Fiber optic cable from ECG Gating Board may be bad.	Replace cable.
	• Main Board or VSM Board may be bad.	Replace Board(s)

Symptom	Problem	Solution
No NIBP reading displays	• Check for leaks in cuff or cuff hose.	Replace with known good cuff or hose.
	• Tubing at NIBP module at base of unit may be pinched or loose.	Reseat or replace loose or pinched tubing.
	• Tubing at the pressure transducer on the Main Board or at receptacle at top of unit may be pinched or loose.	Reseat or replace loose or pinched tubing.
	• NIBP module may be bad.	Replace NIBP module.
Unit does not communicate with the remote display	• Fiber optic cable to remote display may be loose or disconnected.	Reseat or reconnect fiber optic cable.
	• Fiber optic cables not connected properly	Make sure that the fiber optic cables go from “TX” to “RX”. They should NOT go “TX” to “TX”/”RX” to “RX”
	• Fiber optic cable may be bad.	Replace fiber optic cable.
	• Remote display may be malfunctioning	Try another remote display with the system.
	• Network settings in the *CONFIG.* menu may be incorrect.	Reset network settings to correct settings.
	• Communication Board may not be seated tightly to the Main Board.	Verify Communication Board is seated to the Main Board.
	• Communication Board may be bad.	Replace Communication Board
SpO_2 is “noisy”	• Sensor may be bad.	Replace the sensor.
	• Receptacle may be damaged.	Replace receptacle.
	• The connection between Main Board J17 and VSM Board P1 is loose or disconnected.	Reseat the connection.
	• Main Board or VSM Board may be bad.	Replace Board(s)
Temperature not working properly (readings are out of spec.)	• The connections on the Temperature Board are loose or disconnected.	Reseat the connections.
	• Temperature cables or Board may be bad.	Replace Board and cables.

Troubleshooting and Repair

Before attempting to repair a damaged monitor the technician must fully understand the functions of the monitor. The service technician should have read and understood all the previous sections of this manual.

You must fully repair, calibrate, and test all damaged monitors before you use them on patients. The monitor must meet the original operating specifications before you use it on a patient.

Always follow ESD precautions when performing any of the procedures discussed in this section.

Main Board

The Main Board contains the primary processors, storage memory, NIBP circuitry, communication interfaces, audio driver, vital signs module connections, low voltage power regulation, and video generation and keypad inputs (User I/O).

The Main Board has an adjustable pot R84 that you set during NIBP calibration. There are two CPUs on the Main Board that you must program from a Service Download Station. The programmable settings remain in non-volatile memory. Repair or improper handling of the Main Board can corrupt this software.

There are two replacable 3-amp time-delay fuses (F1 and F3) for the battery input at PS1. There is one replaceable 4-amp time-delay fuse for the power supply module at PS2 (F2 protects the supply output).

If you replace the Main Board you are required to cal-check the NIBP module. NIBP pneumatics assemblies and Main Boards may not be changed unless re-calibrated.

The Main Board is not a field-repairable component. Replacement Main Boards are pre-tested, programmed, and calibrated.

⚠DANGER⚠

- High Voltage! Remove the battery connections before servicing the Main Board.

Power Supply

⚠DANGER⚠

- High Voltage! Repairing and testing the power supply requires working with dangerous voltages. The power supply module should only be serviced by experienced electrical repair technicians.

The external power supply is not field servicable. Return the power supply to MEDRAD for service.

Fuse Replacement

The main fuses for the power supply is located in an external compartment above the AC power cord connection. Replace only with T 4A L 250V fuses.

You do not have to open the power supply case to change the main power fuses. See “Fuse Replacement” on page 2-4.

⚠WARNING⚠

- Shock hazard. Substitution of fuses or jumping the fuse contacts can endanger the patient and damage the monitor.

4 *Main Monitor Theory of Operation*

Power Module

The patient monitor employs a universal switching power supply for international use.

In order to monitor the status of the line power and the condition of the battery pack, the internal power supply circuitry drives several status lines available to the main module. The power management/ watchdog circuit provides a low battery level detection mechanism and a hardware-based check on software operation (watchdog timer).

Main CPU and System

The microprocessor circuitry handles the Main Board computational functions and provides integrated I/O functions, including timers, I/O pins, serial interfaces, and analog I/O.

The CONM module contains a microprocessor and associated circuitry for NIBP and the ability to control the optional Capnometer Module. No electrical connection is made with the patient from the monitor for NIBP. The vital signs parameters are passed to the main module using a serial channel.

Vital Signs Module

The vital signs module is a single printed circuit board with connectors to the Main Board, the ECG input leads, the SpO_2 connector, and the temperature sensor. The vital signs module contains a microprocessor and associated circuitry for pulse oximetry, temperature, ECG signals, and TTI respiration. ECG signals can be either 3-lead single channel or 5-lead triple channel. Patient isolation for galvanic contact is required for the temperature and ECG functions. Patient isolation for non-galvanic contact is required for the pulse oximetry sensor. A CAN Bus passes the vital signs parameters to the main module.

The main module sends the vital signs module control information and the vital signs module sends the main module waveforms and hardware status. The communication cycle is 20 Hz for the vital signs information from the vital signs module, twice a second for the status of the vital signs module, and as needed for the control information from the main module.

Speaker Driver

The speaker drive circuit is a DAC controlling speaker volume and an output pin to control frequency. A software-controlled timer generates a square-wave signal that drives the speaker. Hence any drive frequency has harmonic components and generates no “pure tones.” Applicable standards recommend against the use of pure tones in alarm situations to reduce the risk of an individual with a “notch” hearing deficit missing an alarm.

ECG Module

The patient module receives the physiological ECG data from the patient as either a 5- or 3-lead format (user selectable; a 5-lead placement can be viewed as either 3-lead or 5-lead). The module receives the ECG data along with the gradient and RF noise generated by the scanner. This information is converted to a pulse width modulated light signal which is sent over a fiber optic cable to the main monitor. The monitor converts the light signal to an electronic signal. At that point the information is processed to remove the noise from the ECG signal. The ECG signal is forwarded to the monitor in a format that is capable of being received for processing for display on the monitor screen. Also at this point the ECG signal is made available as a gating signal to the scanner in both a waveform and a pulse.

Pulse Oximeter Module (SpO_2)

The method of measuring the oxygen saturation is spectrophotometry and plethysmography. The sensor is made up of a dual emitter and a detector. The emitter and detector are remote from the patient by a length of optical fibers which remove the electronic components from the patient area. The sensor emits two wavelengths of light: red and infrared. The photodetector measures the intensity of the two wavelengths that pass through the measuring site unabsorbed. The resultant signal is converted to an electrical signal and returned to the monitor where the information is processed and displayed for the user to view.

Capnometer Module (CO_2)

The optional capnometer (Anesthetic models only) contains the circuitry for monitoring the sidestream CO_2 level by actively sampling from the patient's airway. It contains provisions for interfacing with galvanic oxygen monitoring option sub-modules. No electrical connection is made with the patient from the monitor for capnometry. The CONM module controls the capnometer.

The CO_2 Board contains an assembly known as a "bench." This bench contains the optics, IR source, detector, sample cell, and optical filters. The purpose of this bench is to convert CO_2 levels in a gas sample to electrical signals.

The bench assembly utilizes the principle of infrared absorption spectrometry to measure the amount of CO_2 in patients breath. Infrared absorption spectrometry is widely used in gas analysis. Using a phenomenon explained in "Beers Law," CO_2 gas absorbs certain wavelengths of infrared energy with the amount depending on the amount of CO_2 gas. A detector, outfitted with an infrared bandpass filter, only allows a certain wavelength of infrared energy that the CO_2 gas absorbs. As the CO_2 concentrations in the sampled air passes through the sample cell, the detector senses the infrared energy changes and converts them to an electrical signal. This electrical signal is then amplified and conditioned and sent to a microprocessor for processing and then sent to a display.

Infrared analysis of the gas samples is done using Beer's Law. The formula for Beer's Law is as follows:

$$I = I_0 e^{-\varepsilon(\lambda)cd}$$

- I Infrared value of measured sample.
- I_0 Infrared value of light source.
- e Exponential function.
- $\varepsilon(\lambda)$ Extinction coefficient.
- c Concentration of the gas sample
- d Distance measured through the sample

The CO_2 Board also uses a reference channel. The purpose of this reference channel is to "cancel" the effects of IR source changes, sample cell contamination, temperature, etc. The only difference from the CO_2 channel is that the detector is outfitted with an optical filter that is tuned to a band in the infrared spectrum that is transparent to CO_2 and other gases typically found in the medical industry. The signal from the reference channel is processed similarly to that of CO_2 measurement channel.

The CO_2 and reference detectors work by an effect known as "pyroelectric." Pyroelectric effect works by changing energy levels, either increasing or decreasing, that are imposed on a sensing element. The detector is outfitted with an optical bandpass filter that passes only a narrow band of a determined wavelength of infrared energy. The infrared source is modulated at 15 hertz (Hz) to provide varying energy for the detector and amplifier circuits.

Correction for temperature and pressure effects on the CO_2 sample is implemented to maintain accuracy over a wide temperature and atmospheric pressure range.

Galvanic Oxygen Sub-Module (O_2)

The galvanic oxygen-monitoring sub-module contains the control and signal acquisition circuitry for monitoring the O_2 level in the airflow drawn by the capnometer module. It is an optional daughter board on the capnometer module. No electrical connection is made with the patient from the monitor for oxygen monitoring.

The relationship between gas concentration and pressure is calculated by the microprocessor. The numerical value displayed by the monitor (O_2 Calculated) is generated using the following formula.

$$O_2\ \text{Calculated} = O_2\text{Measured} \times \frac{20.9}{O_2\text{Ambient}} \times \frac{P_C}{P_0}$$

The measured O_2 predictive value is multiplied by a fixed value derived from room pressure divided by room ambient oxygen levels. The measurement is further adjusted by multiplying the ratio of the pressure determined at calibration (P_C) with the current pressure (P_0).

Temperature

The ***Veris*** monitor uses a fiber-optic thermometer to measure temperature. This provides accurate and reliable measurements in the MRI environment.

This sensor probe features an environmentally inert, non-conductive, non-metallic, miniature probe, making it ideal for harsh operating conditions like the MRI environment, which includes conditions where high levels of electromagnetic interference (EMI) such as RF field or high voltages exist. The probe itself is inert to chemical and biological agents and is ideally suited to applications where a completely non-reactive sensor is required or where other types of sensors would malfunction or become damaged.

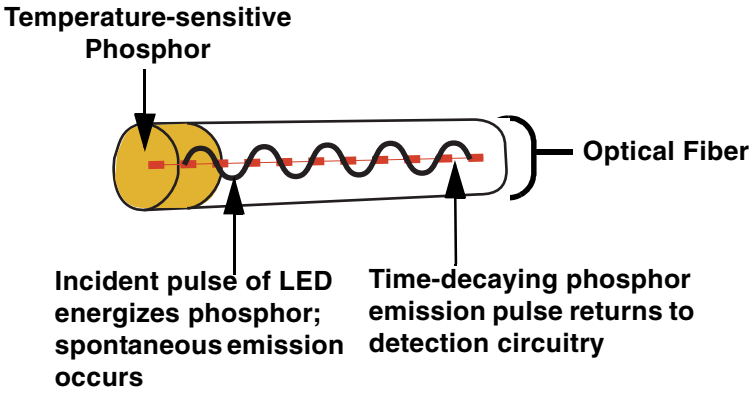

Temperature-sensitive Phosphor
Optical Fiber
Incident pulse of LED energizes phosphor; spontaneous emission occurs
Time-decaying phosphor emission pulse returns to detection circuitry

Figure 4-1: Temperature Probe Signals

The temperature system is comprised of a probe, a fiber optic cable, detection optics, and signal processing, and interfaces contained within the main monitor. The probe itself contains a patented, highly temperature-sensitive phosphor as its sensing element, and both the probe and phosphor are protected by a fluoropolymer sheath. The standard cable length is 3 meters.

The temperature system uses a fluorodecay sensing technique. Pulsed light from an LED is sent down the optical fiber to energize the phosphor. The time decaying glow of the phosphor changes with temperature and is transmitted back to the sensor head where it is converted to a temperature reading. The temperature system uses a unique ratio measurement system to minimize inaccuracies due to signal loss from the fiber and connector.

The temperature system is fully calibrated at the factory. Each probe contains its own calibration data within an embedded memory module.

Communications

The monitor provides two patient-isolated external RS-232 serial data ports (TX, RX, and ground):

- The DB-9 COM1 port is configured for compatibility with ASCII printer applications.
- The DIN-8 COM2 port is custom-configured with one pin reserved for analog output.

The main module drives a patient-isolated external analog output. It provides a 0 to 1 v output capable of driving a high-level input, such as a defibrillator or chart recorder.

Gating

The gating function provides an analog signal output to the scanner. When this signal is detected by the scanner, the scanner initiates the image acquisition based on the signal received. The function provides two types of signals to the scanner: waveform and pulse. These signals are derived from two sources: ECG and SpO_2. The waveform signal is the signal as extracted from the patient, processed by the monitor, and sent to the scanner input. The pulse signal consists of a pulse coincident with the R-wave or the peak of the SpO_2 wave with a pulse width such that the scanner can detect the signal, and amplitudes equivalent to the peaks of the waveform.

The system provides appropriate gating signals at least 97% of the time keeping false positives and false negatives to less than 3%.

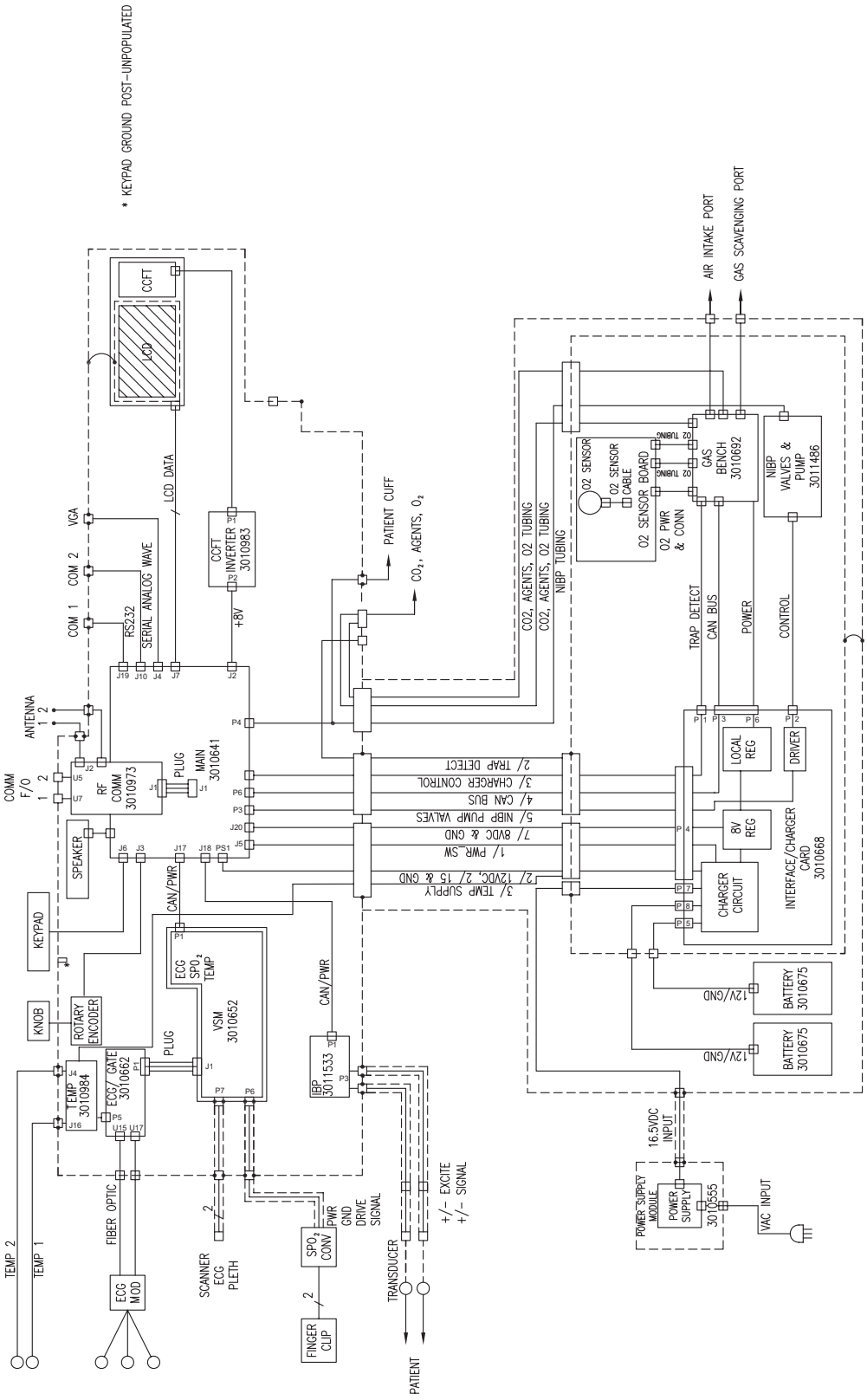
The user selects which type of signal and the source of the signal from the parameter menu. The interface cabling from the system to the scanner is scanner specific for the major scanners. For other scanners, a universal gating cable interface is available.

Printer

The printer only comes with an optional remote display.

Block Diagram

The following block diagram aids in tracing communication and data routes within the system. The diagram is keyed to the theory of operations found on the previous pages.



5 *Main Monitor Disassembly*

Before You Begin

Tools Needed

- Proper ESD mat and antistatic grounding straps
- #1 Philips screwdriver
- #2 Philips screwdriver
- Small flat scredriver
- 1/2-inch socket, deep well
- 5/16-inch socket, deep well
- 3/16-inch socket, deep well
- 1/2-inch wrench
- 3/8-inch wrench
- 1/2-inch nut driver
- 5/16-inch nut driver
- 1/4-inch nut driver
- 3/32-inch Hex key
- Grounded soldering iron

Supplies Needed

- Kapton tape
- Labeling material
- Cotton cloth
- Rubbing alcohol

Precautions

1. Turn the monitor off.
2. Disconnect the A.C. (Mains) power cord and remove the batteries.

⚠WARNING⚠

- The procedures presented in this section are intended to be implemented by qualified biomedical engineering or field service personnel for PCB assembly replacement.
- The procedures presented in this section are not intended to be used for component-level trouble shooting and repair of the PCB assemblies. Only MEDRAD service personnel are authorized to perform component-level repair.
- Possible safety hazard. Read the battery safety information provided in “Replacing the Batteries” on page 5-21

The repair procedures for the monitor are included here for the determination of damaged or unusable assemblies. MEDRAD does not recommend attempting the field repair of the circuit boards.

Service Safety

⚠DANGER⚠

- The patient monitor uses an external AC power supply that contains potentially lethal voltages.

Electrostatic Discharge Protection

The procedures in this section require handling of electrostatic sensitive components. Microprocessors and other electronic components can be permanently damaged by attempting repairs at an unprotected workbench.

Use all electrostatic discharge (ESD) protection as described!

- Perform the disassembly procedure on an antistatic mat that is grounded. Check the ground cable to insure that it is connected to a good earth ground.
- Use a grounded soldering iron.
- Wear a wrist-grounding strap.
- Connect the wrist strap and mat through a resistor (1 megohm typical) to the same ground source.
- Test the wrist-ground straps on a daily basis.
- Temporarily store components in metal or antistatic containers. Do not store components in plastic dishes. Store circuit boards in sealed antistatic bags or cover them in antistatic boxes. Do not store electronic boards directly in cardboard boxes.

Front Housing Removal

Follow the ESD cautions discussed in “Electrostatic Discharge Protection” on page 5-2.

⚠CAUTION⚠

- Keep the base cover in place to prevent hardware from dropping onto components in the base of the system.

1. Remove the covers from the communication ports.

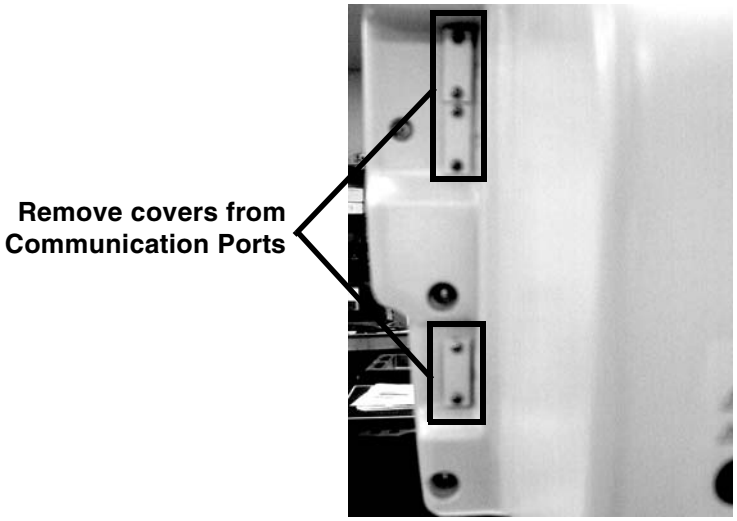


Figure 5-1: Communication Port Covers

2. Remove the nine (9) screws from the bottom of the display.

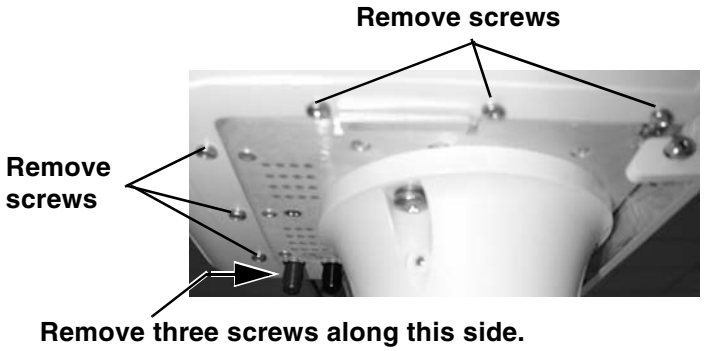


Figure 5-2: Screws on Bottom of Display

3. Remove the 12 screws holding the front and rear assemblies together and the two (2) screws by the handle. When the screws are removed, the rear housing slides off toward the back.

   NOTE: The screws have lock washers.

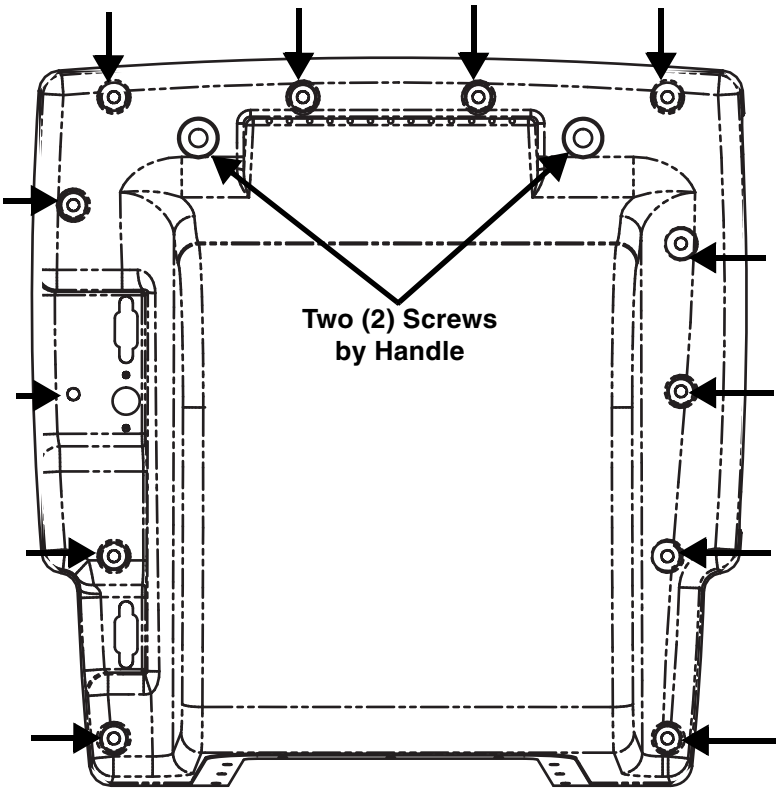
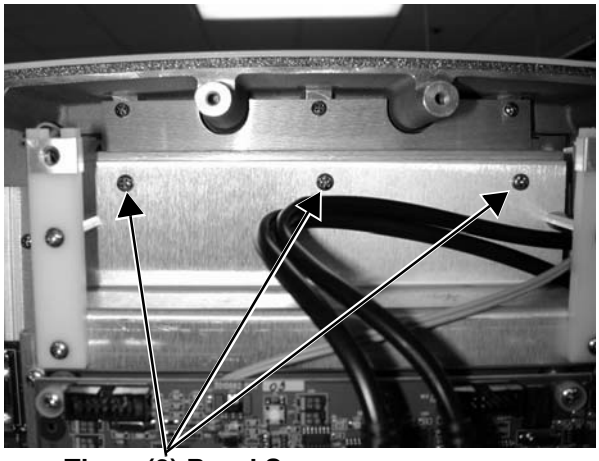


Figure 5-3: Screws on the Back of the Monitor

4. Remove the three (3) screws holding the front bezel in place.

   NOTE: When you remove the screws, carefully lower the front bezel to avoid damaging the ribbon cable.



Remove Three (3) Bezel Screws

Figure 5-4: Remove Bezel Screws

5. Label and remove the ribbon cable from J7 on the Main Board.

6. Label and remove the water trap tubes.

NOTE: Trim the tubes back in reassembly to create a good seal.

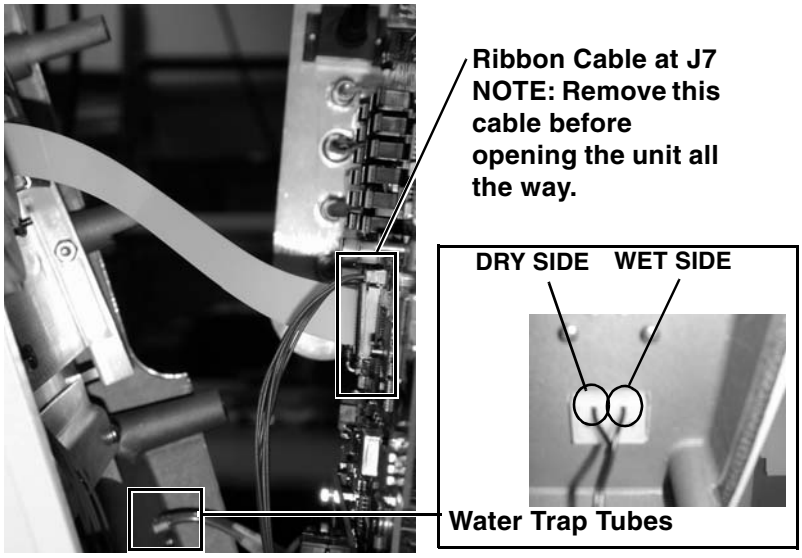


Figure 5-5: Remove Ribbon Cable at J7

7. Label and disconnect from the Main Board:
   - the backlight cable from J2,
   - the rotary encoder cable from J3, and
   - the membrane switch cable from J6.

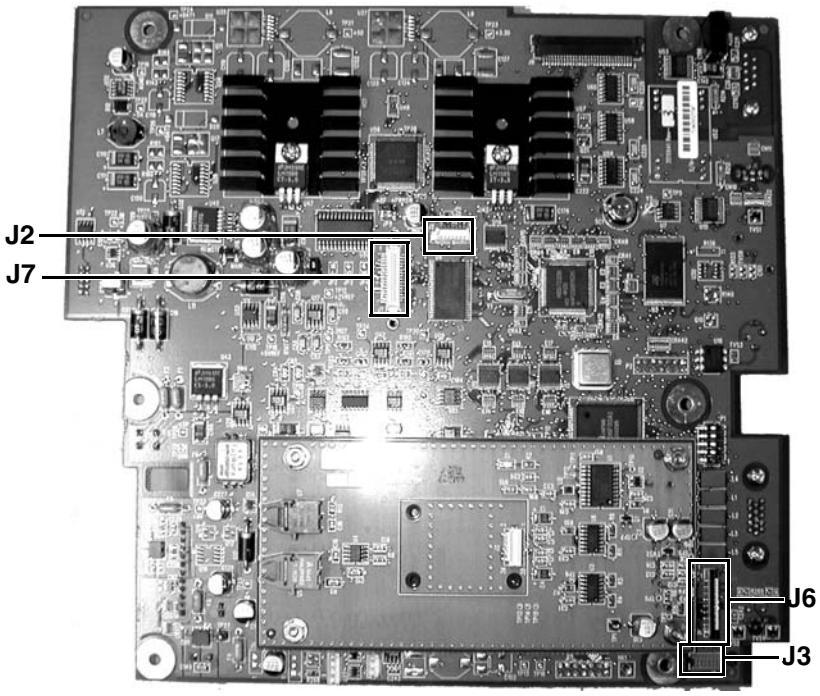


Figure 5-6: Main Board Connections

8. *If the patient monitor has a fiber optic connection to the main monitor*, label and disconnect the fiber optic cables from U5 and U7 on the DPAC Communication Board.

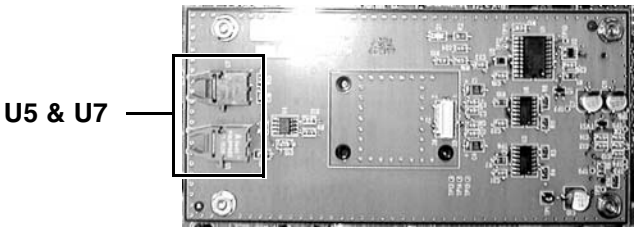


Figure 5-7: DPAC Assembly

9. *If the DPAC Communication Board needs to be replaced*, remove the DPAC Communication Board from the Main Board.

   If only the Main Board needs to be replaced, remove the DPAC Communication Board from the Main Board as an assembly to attach to the new Main Board.

   NOTE: The DPAC Communication Module is not provided with a replacement Main Board. Retain the DPAC Communication Module from your existing system and attach to the new Main Board.

10. Remove the Main/Communication assembly from the chassis. This assembly is held with six (6) #6 screws.

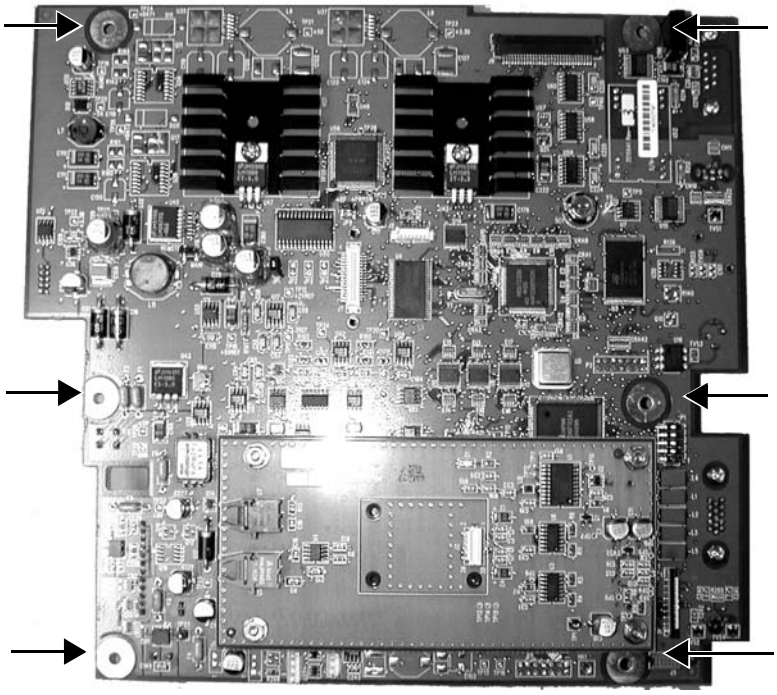


Figure 5-8: Remove the Six Screws

Front Housing Disassembly

1. Remove the two (2) hex-head screws.

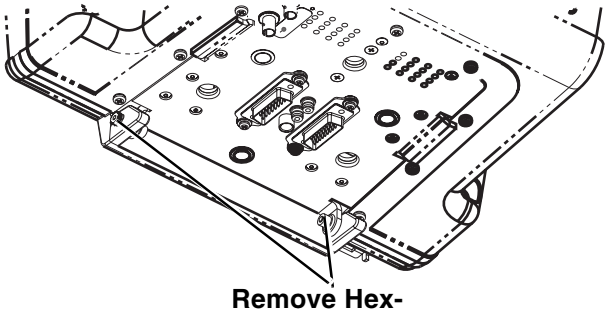


Figure 5-9: Remove Hex-head screws.

2. Remove the front display assembly from the chassis.

Rotary Encoder Knob Removal and Replacement

1. With a flat screwdriver pry the rotary encoder knob from the unit.

Figure 5-10: Remove the Rotary Encoder Knob

2. Remove the retaining nut and lock washer from the front of the housing.

3. *If you need to replace the rotary encoder knob assembly*, Insulate the new rotary encoder knob assembly with Kapton tape.

4. Install the rotary encoder knob assembly and tighten the nut and lock washer.

5. Install the rotary encoder knob.

Membrane Keypad Removal and Replacement

Use this procedure only if you need to replace the membrane keypad on the monitor.

NOTE: Once you remove a membrane from the front panel you cannot reattach it to the front panel.

1. With a flat screwdriver pry the rotary encoder knob from the unit.

Figure 5-11: Remove the Rotary Encoder Knob

2. Push a flat screwdriver through the ribbon cable slot to begin peeling the membrane off the front of the unit. Do not attempt to use tools to peel the membrane from the front as you may mar the case and be unable to properly attach the new membrane.

Figure 5-12: Removing Membrane

3. Peel the membrane away from the front housing.

4. Remove any excess glue from the front housing. Use a cotton cloth dampened with alcohol. If any glue remains on the housing, the new membrane cannot adhere properly.

5. Remove the protective backing from the adhesive on the new membrane.

6. Install the new membrane. Line up the membrane along a straight edge and lay the membrane into place. Press down firmly on the membrane when it is in position.

7. Reattach the rotary encoder knob to the front housing.

Water Trap Manifold Removal/ Replacement

1. Remove the two (2) Phillips screws from the back of the housing.

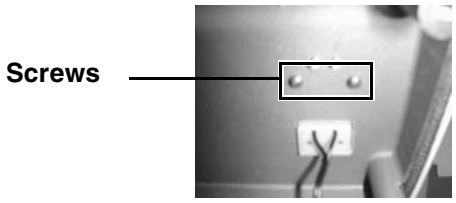


Figure 5-13: Remove the Water Trap Manifold

2. Unplug the manifold from the wire. The wire disconnects at a junction between the chassis and the manifold.

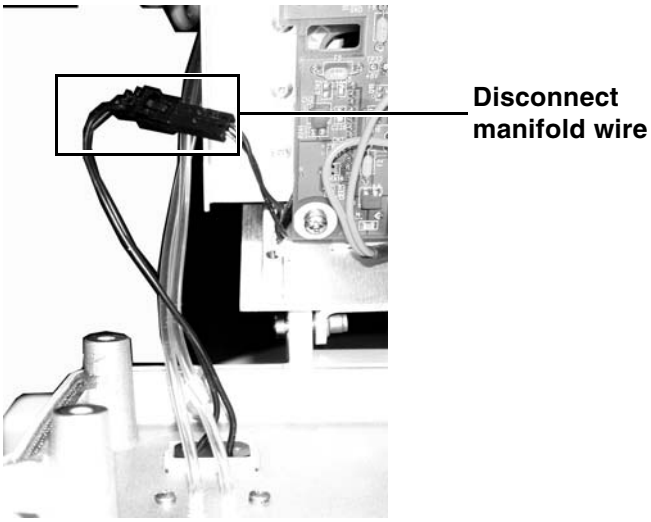


Figure 5-14: Wire to CO_2 Manifold

3. When you install the new manifold, be sure to insert the lower tab into the recess first.

4. Replace the two (2) Phillips screws.

Inverter Board
Removal and Replacement

⚠CAUTION⚠

- High Voltage! The Inverter Board will contain high voltage. Use caution when servicing the Inverter Board and/or the front display assembly.

1. Label and disconnect the cables (Item 1 on the photo) on the Inverter Board.

2. Remove the four (4) nuts and lock washers.

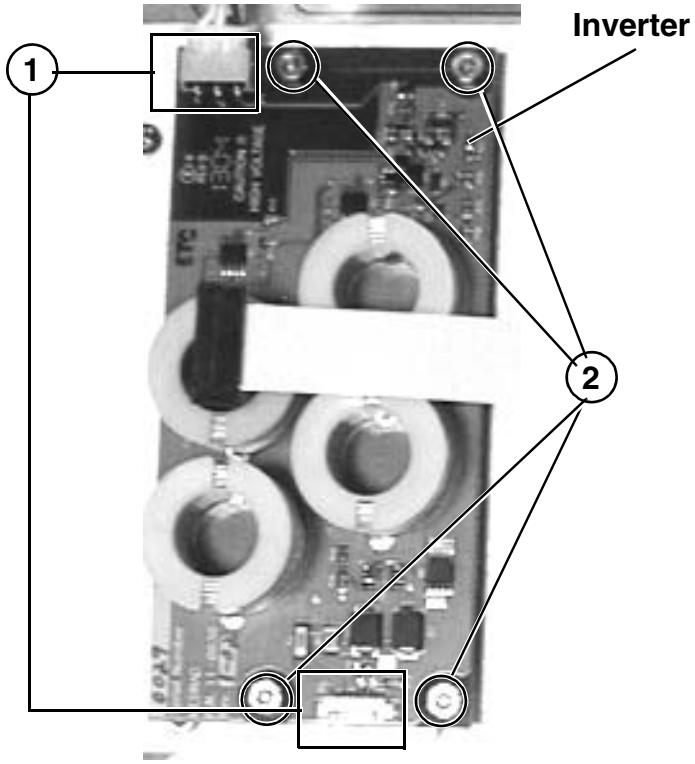


Figure 5-15: Remove the Inverter Board

3. Remove and replace the Inverter Board.

4. Fasten the new Inverter Board with the four (4) nuts and nylon washers you removed earlier. (See #2 in "Figure 5-15:Remove the Inverter Board".)

   NOTE: When you install the new Inverter Board, be sure the nylon standoffs are in place.

5. Reattach the cables. (See #1 in "Figure 5-15:Remove the Inverter Board".)

Display Screen
Removal and Replacement

⚠CAUTION⚠

- High Voltage! The Inverter Board will contain high voltage. Use caution when servicing the Inverter Board and/or the front display assembly.

1. Remove the 10 Phillips screws: three (3) at the top, three (3) at the bottom, two (2) at each side.

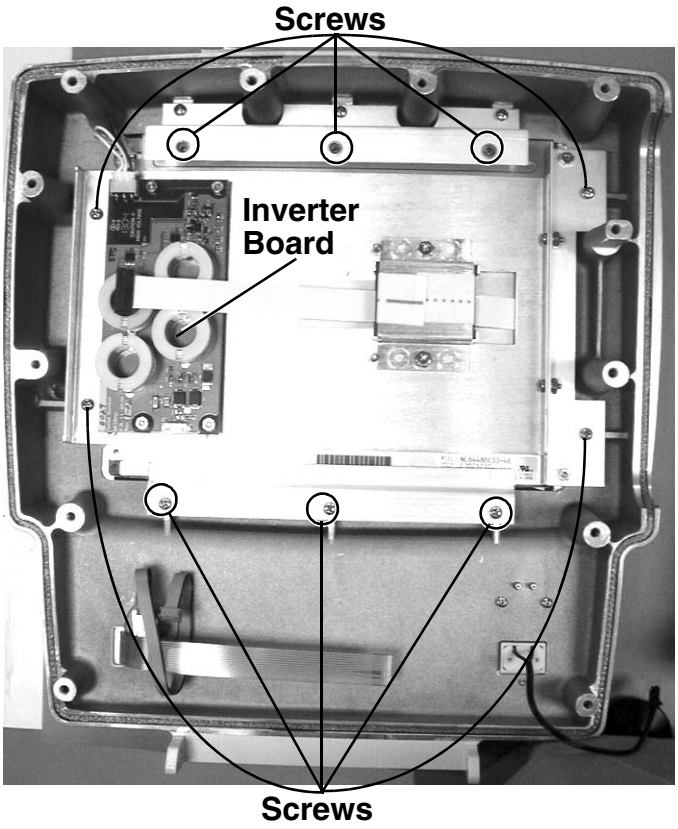


Figure 5-16: Remove the Display Housing Screws

2. Label and disconnect the cable at Label 2 from the Inverter Board.

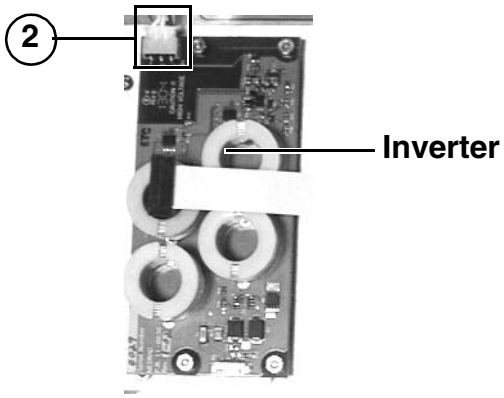


Figure 5-17: Remove the Inverter Board Connection

3. Disconnect the ribbon cable from the display.

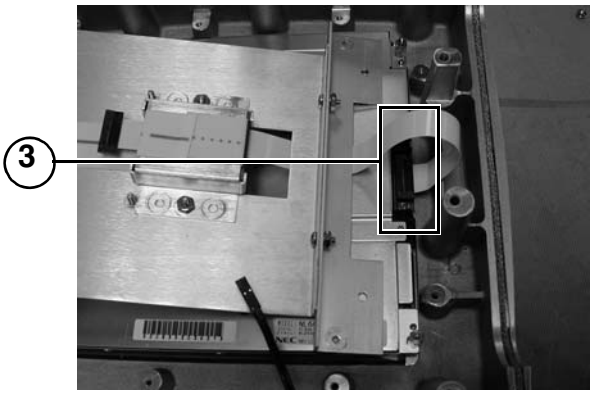


Figure 5-18: Remove the Ribbon Cable, Display Screws

4. Turn the display over and remove the four Phillips screws.

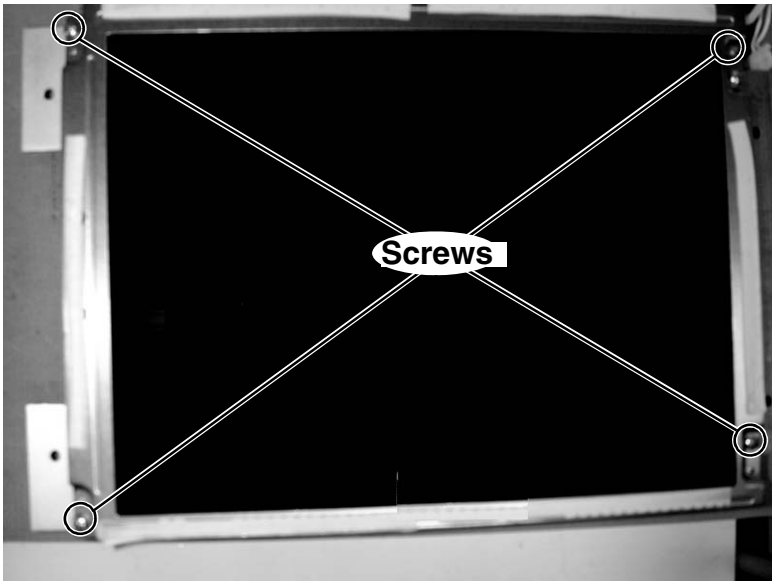


Figure 5-19: Remove the Display Screws

5. Remove and replace the display screen.

   NOTE: Be sure the display and the inside of the clear cover are clean before you re-assemble the assembly. See “Cleaning and Disinfecting” on page 2-3.

6. Reassemble in reverse order.

   NOTE: Make sure the EMI window is centered and installed with the painted border towards the gasket on the front of the unit.

Replacing Printed Circuit Boards (PCBs)

The Vital Signs Module (VSM) Board, the Temperature Board, and the IBP Board are found behind the Main Board.

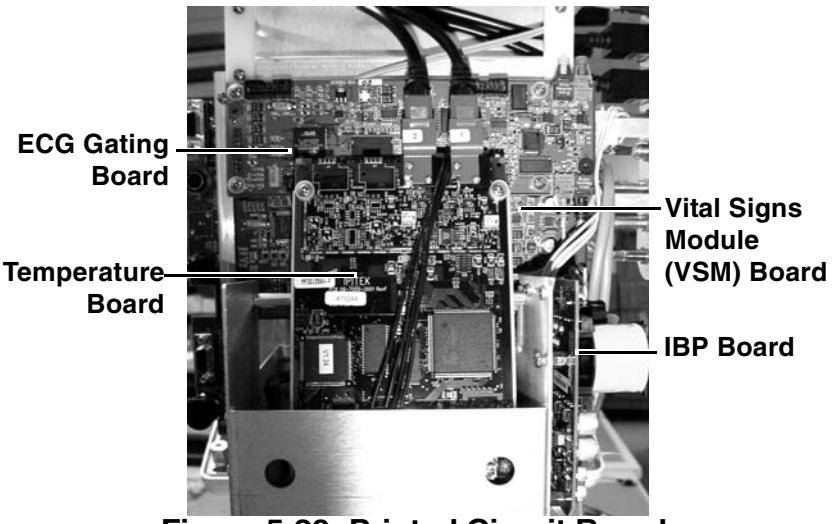


Figure 5-20: Printed Circuit Boards

IBP Board

NOTE: This PCB is only on Cardiac and Anesthetic models.

1. Label and remove the cable from P1 and P3 on the IBP Board.

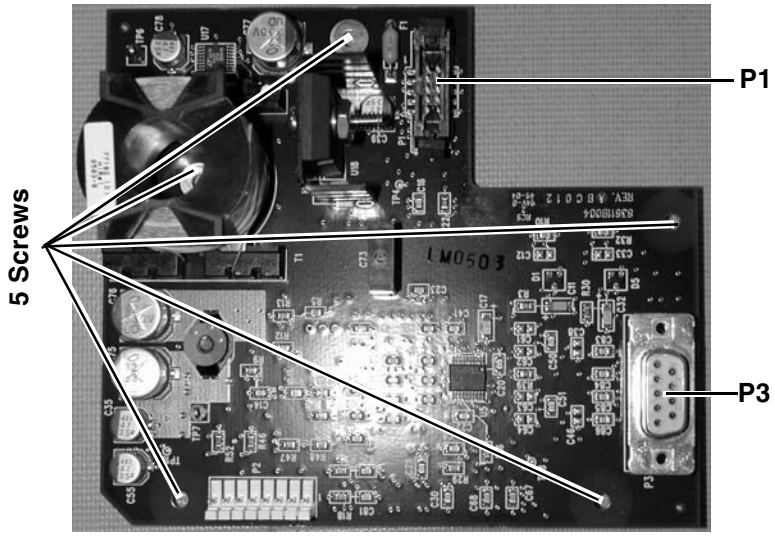


Figure 5-21: IBP Board

2. Remove the five (5) Phillips screws holding the board to the chassis.
3. Remove the old board.
4. Install the new IBP Board.
5. Attach the cable from Main Board J18 to P1 on the IBP Board. Attach the patient connector cable to P3 on the IBP Board.
6. Reassemble in reverse order.

Temperature Module/Board

NOTE: This PCB is only on Cardiac with Temperature and Anesthetic with Temperature models.

1. Remove the four (4) screws from the Temperature Board.

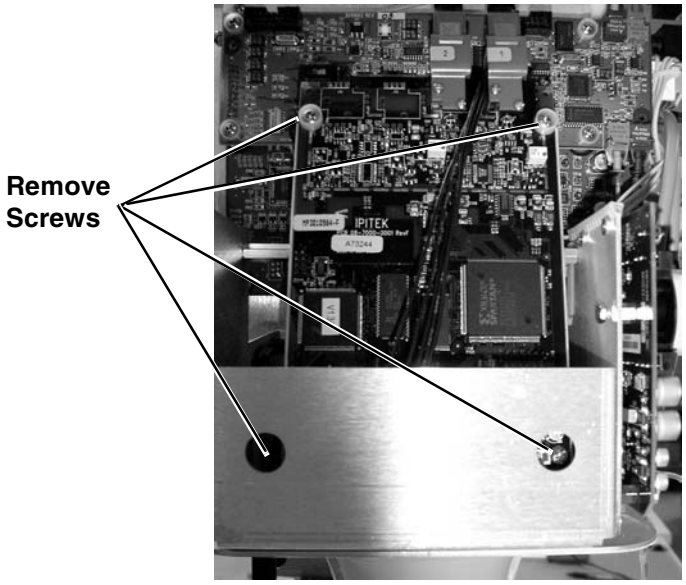


Figure 5-22: Temperature Assembly

2. Remove the cables from J4 and near J16 from the Temperature Board.

   NOTE: The cables are matched with the Temperature Board. The new Temperature Board should come with new cables. If the new board does not have cables, contact MEDRAD Service.

3. Remove the four (4) Philips screws at the patient connector.

4. Reassemble in reverse order. Make sure that Cable 1 attaches to T1 at the patient connector and Cable 2 attaches to T2 at the patient connector.

ECG Gating Board

⚠CAUTION⚠

- The ECG Gating Board is attached to the Vital Signs Module (VSM) Board at J1 on the VSM Board. Be careful when removing the ECG Gating Board from the VSM Board.

1. Label and remove the temperature cable at P5 (if unit has temperature) and the ECG cables at U15 and U17 on the ECG Gating Board.

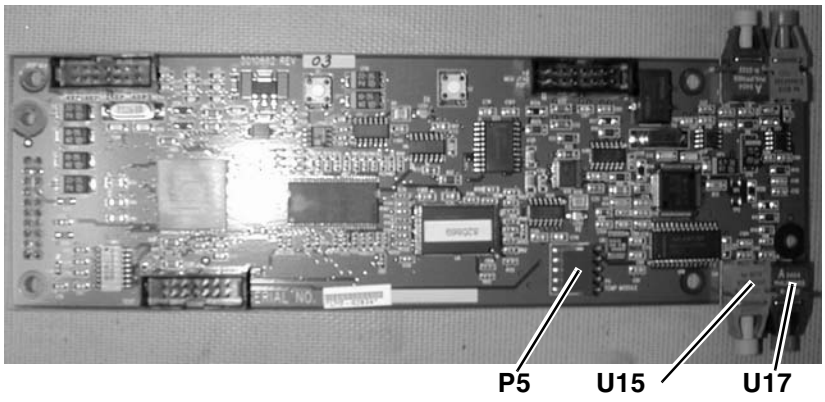


Figure 5-23: ECG Gating Board

2. Remove the four (4) Phillips screws holding the ECG Board to the VSM Board.

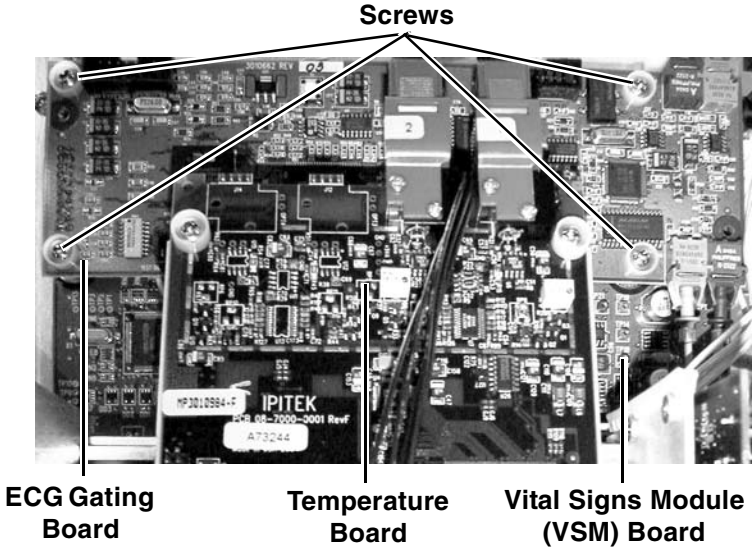


Figure 5-24: Removing ECG Gating Board

3. Attach new ECG Gating Board to the VSM Board with the four (4) Phillips screws removed earlier.

4. Reattach the emperature cable at P5 and the ECG cables at U15 and U17 on the ECG Gating Board.

Vital Signs Module (VSM) Board

⚠CAUTION⚠

- The Vital Signs Module (VSM) Board is attached to the Main Board between P1 on the VSM Board and J17 on the Main Board. Be careful when removing the VSM Board from the Main Board that you do not bend the pins when removing the VSM Board.

1. Remove the ECG Gating Board (see “ECG Gating Board” on page 5-16).

2. Label and remove the cables from P6 and P7.

   NOTE: P7 has no cable on Base and BasePlus models.

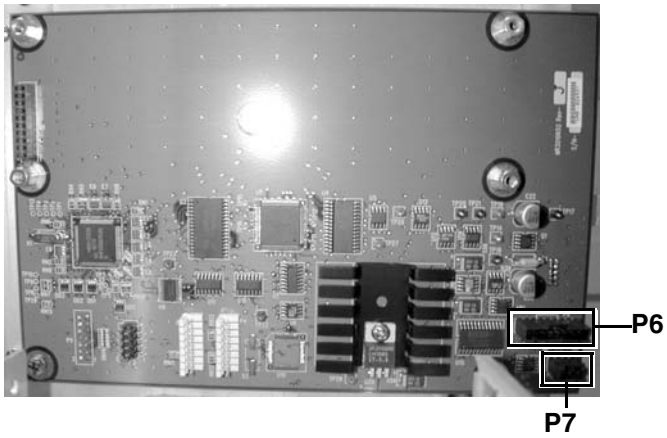


Figure 5-25: VSM Board

3. Remove the two (2) Phillips screws holding the board to the standoffs. Remove the standoffs.

4. Being careful not to bend the pins connecting the VSM Board (P1) to the Main Board (J17), remove the board from the assembly.

5. Being careful not to bend the pins connecting the VSM Board (P1) to the Main Board (J17), install the new board into the assembly with the two screws removed earlier.

6. Reattach the cables at P6 and P7.

7. Reassemble in reverse order.

Replacing the Post

1. Remove the three (3) panhead screws holding the monitor to the top of the post. Lift the monitor up by the handle and set in a safe place.

2. Loosen the three (3) Allen head screws from the collar. Remove the collar from the top of the post

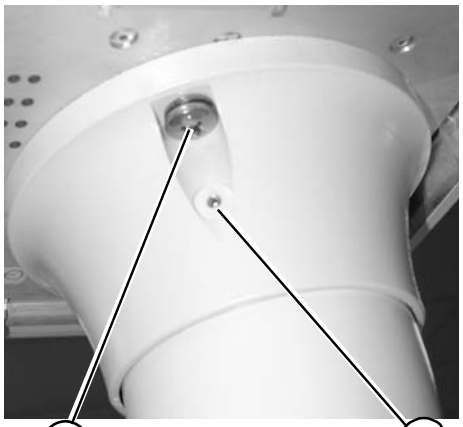

1
2
Remove panhead screws holding monitor to the post (three total)
Loosen Allen head screws holding collar to the post (three total)

Figure 5-26: Removing top assembly from post

3. Remove the three screws from the tray collar. Remove the tray from the post.

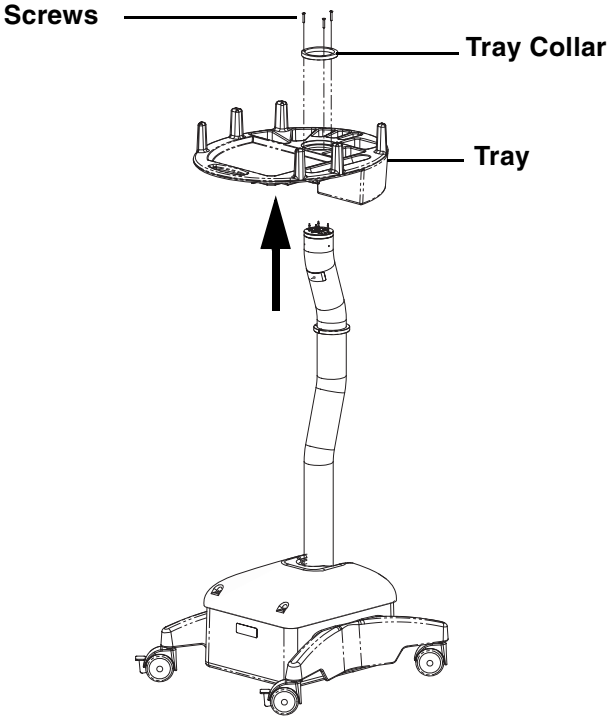


Figure 5-27: Removing Tray from Post

4. Remove the eight (8) screws from the cosmetic base cover.

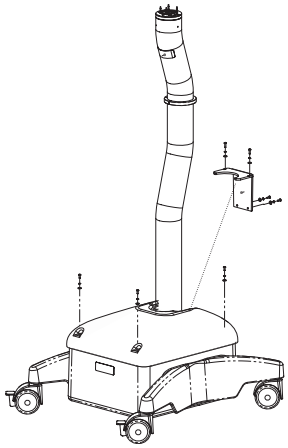


Figure 5-28: Remove Cosmetic Cover

5. Remove the four (4) Nylock nuts holding the post to the base.

6. Remove the old post from the base.

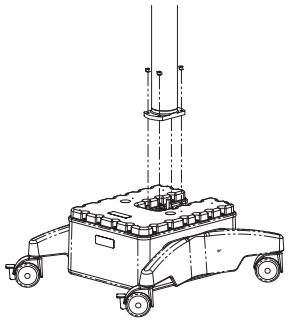


Figure 5-29: Remove Post from Base

7. Attach the new post to the base using the four (4) Nylock nuts.

8. Reattach the cosmetic base cover, tray, and tray collar.

9. Attach the monitor to the top of the post with the three (3) panhead screws.

10. Send the old post back to MEDRAD.

Base Disassembly

1. Remove the four (4) screws holding the fascia to the base. Remove the cosmetic flap above the DC inlet.

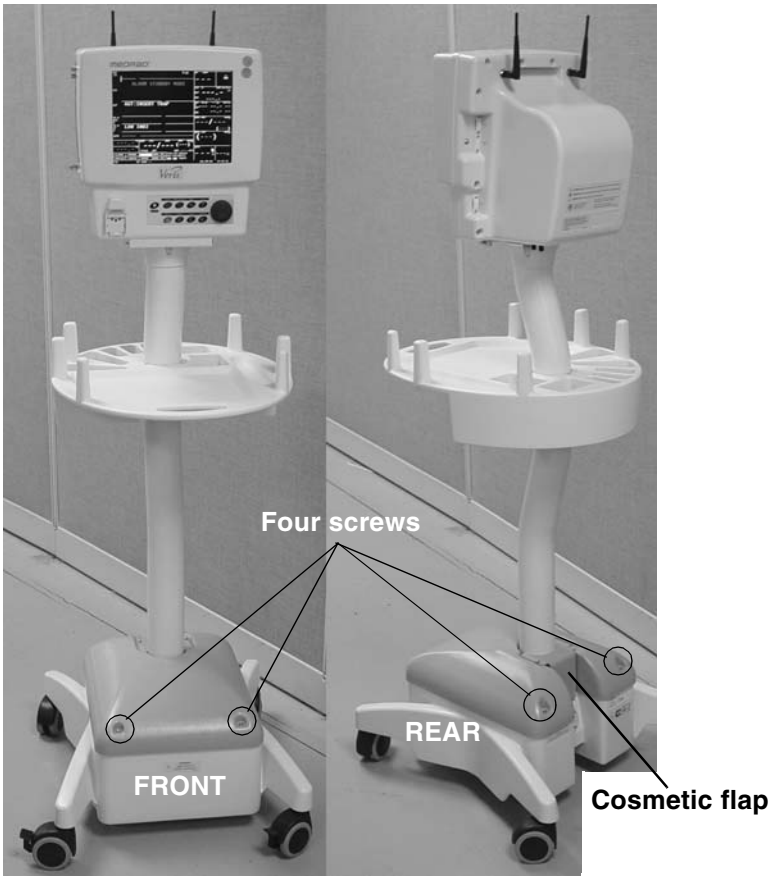


Figure 5-30: Remove the Four Fascia Screws

2. Remove the 30 screws holding the base cover onto the base assembly.

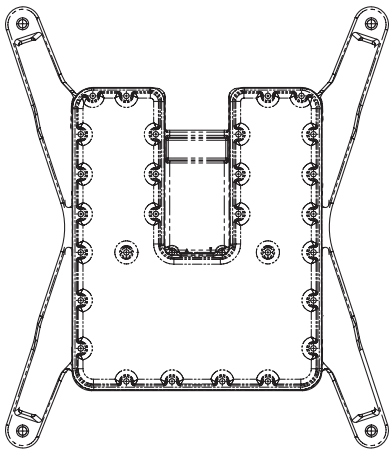


Figure 5-31: Remove 30 Screws Holding Cover to Base

Replacing the Batteries

⚠CAUTION⚠

- Do not short circuit the battery terminals! The resulting high-current discharge can cause burns.
- Charge the battery completely after extended battery use to ensure a fully-charged battery is available for the next use.
- Explosion hazard! Keep lighted cigarettes, sparks, and flames away from the battery.
- The battery contains sulfuric acid electrolyte that can cause severe burns and eye damage, as well as illness from sulfur oxide fumes.
- Do not crack, cut, burn, or dissolve (with solvents) the battery case. Damaging the battery case can cause the release of sulfuric acid. If sulfuric acid is released from the battery, wear eye protection and rubber gloves to handle the battery, and use a solution of baking soda in water to neutralize the sulfuric acid.
- Do not incinerate the batttery. The used battery is a potential environmental hazard and must be disposed of properly. Dispose of the old battery in accordance with local and federal laws.

1. Label and disconnect the battery cables from P5 and P8 on the Charger PCB Assembly.

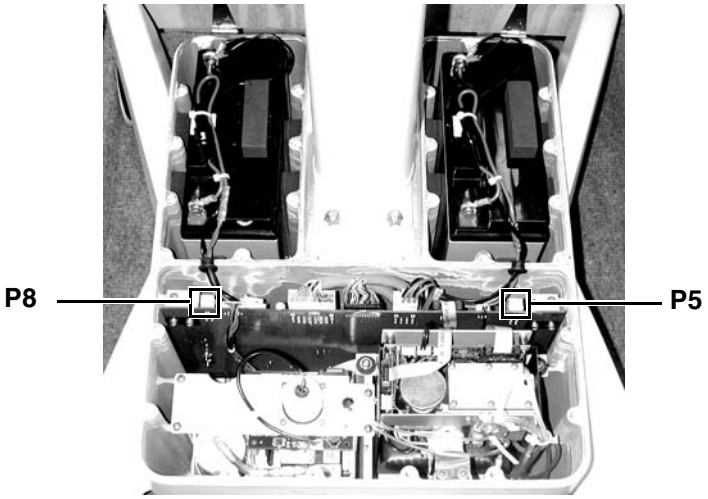


Figure 5-32: Battery Connections on the Charger Board

2. Remove the batteries from the base.
3. Replace with new battery assemblies.
4. Connect the batteries to P5 and P8 on the Charger PCB Assembly.

Replacing the NIBP Chassis Assembly:

1. *If the unit has and O_2 assembly*, remove the four (4) screws that hold the O_2 assembly in place. Remove the O_2 assembly and set in a safe location.

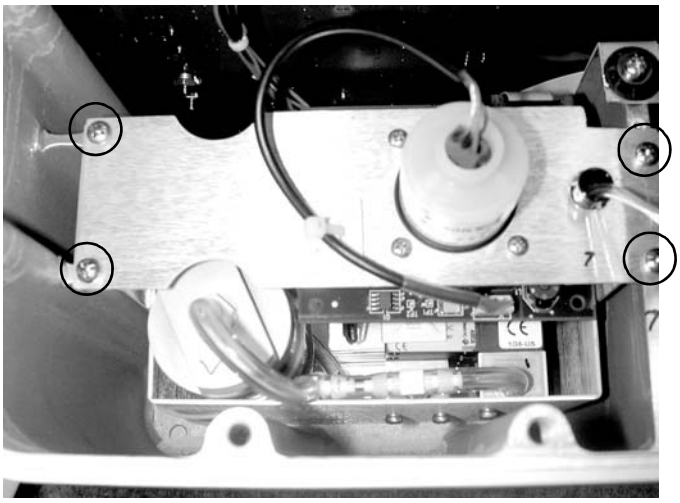


Figure 5-33: Remove O_2 Assembly

2. Disconnect the 1/8-inch tubing on the NIBP Assembly from the base assembly.

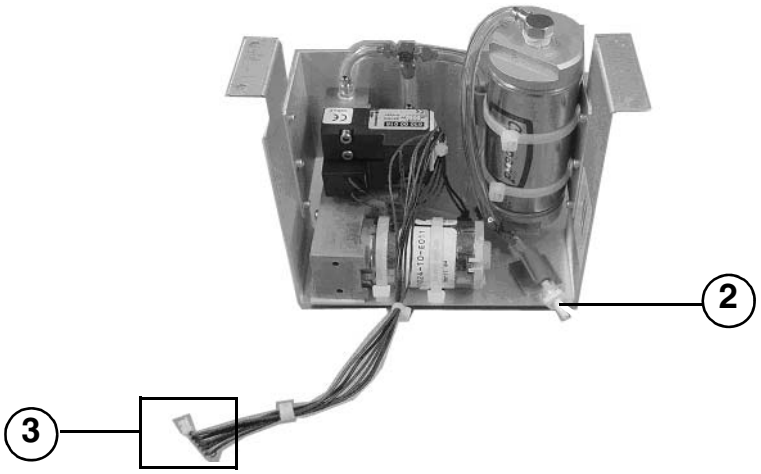


Figure 5-34: NIBP Assembly

3. Label and disconnect the pneumatic cable from P2 on the Charger PCB.
4. Remove the NIBP chassis assembly.
5. Place new NIBP chassis assembly into unit.
6. Reconnect the pneumatic cable to P2 on the Charger PCB.
7. Reconnect the 1/8-inch tubing on the NIBP Assembly to the base assembly.

Replacing the Charger PCB

1. Label and remove the eight (8) cables from P1, P2, P3, P4, P5, P6, P7, and P8 on the Charger PCB.

   NOTE: Some connectors are for anesthetic modules that may not be in the unit and thus have no connections to the Charger Board.

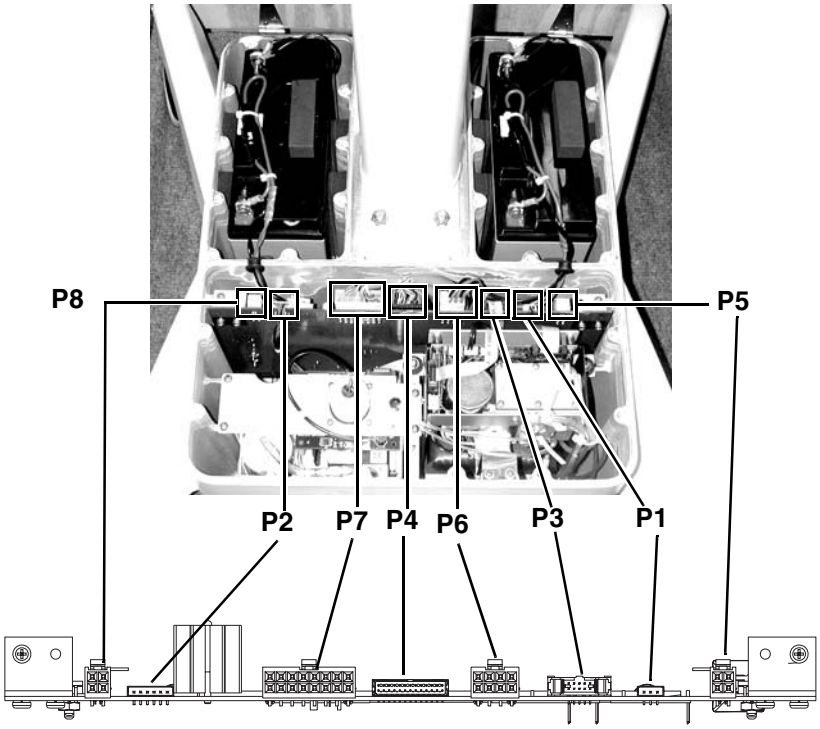


Figure 5-35: Connections on the Charger Board

2. Remove the Charger PCB.

3. Place the new Charger PCB into the unit.

4. Reattach the cables to P1, P2, P3, P4, P5, P6, P7, and P8 on the Charger PCB (each has a unique connection).

Replacing the O_2 Sensor (on Anesthetic Units)

1. Label and remove the cable from the O_2 sensor.

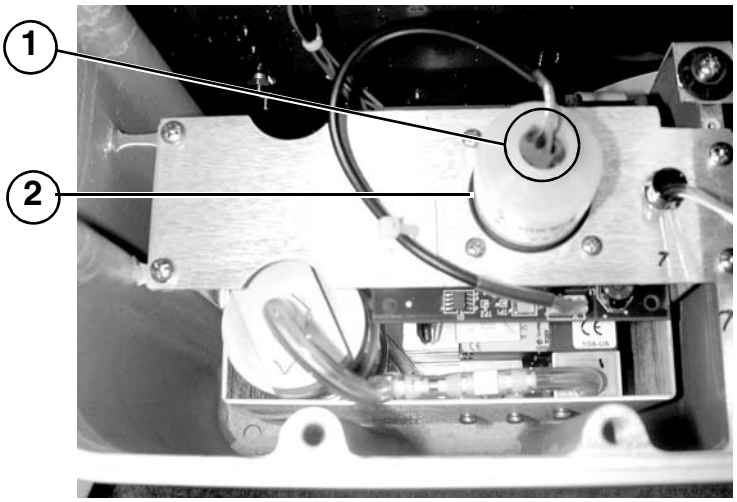


Figure 5-36: O_2 Assembly

2. Unscrew the O_2 sensor module from the O_2 PCB.
3. Place a new O_2 sensor (pn 3010970) into socket.
4. Reattach the cable to the O_2 sensor.

Replacing the CO_2 Absorber (on Anesthetic Units)

1. Label and disconnect the tube marked “Absorber” from the CO_2 absorber.
2. Remove the absorber from the wire clip located on the front wall.

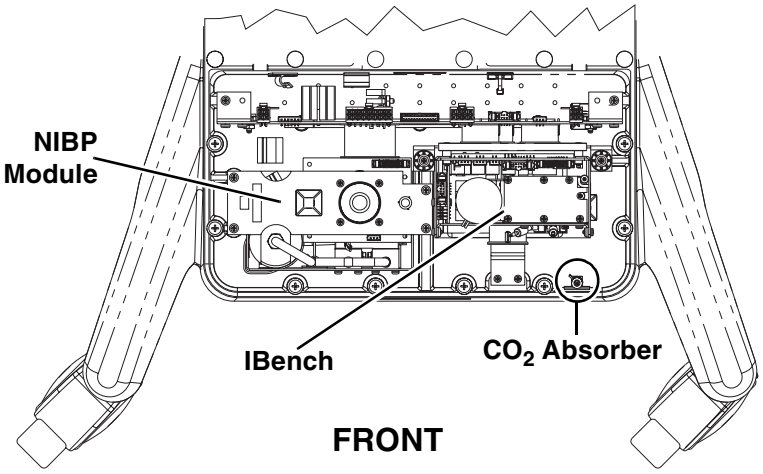


Figure 5-37: CO_2 Absorber

3. Place a new CO_2 absorber (pn 3010971) into the wire clip on the front wall.
4. Attach the tube marked “Absorber” to the new CO_2 absorber.

Replacing the Agent Bench (on Anesthetic Units)

1. Label and disconnect the tubes marked “Wet Side (B1),” “Dry Side (B4),” “Exhaust (B6),” “O2 In (B2),” and “O2 Out (B5)” from the Agent Bench assembly.
2. Label and disconnect the tube marked “Absorber” from the CO_2 absorber and remove the absorber from the wire clip located on the front wall.
3. Remove the Agent Bench assembly from the unit.
4. Place new Agent Bench assembly into unit.
5. Attach the tube marked “Absorber” to the new CO_2 absorber.
6. Attach the tubes marked “Wet Side (B1),” “Dry Side (B4),” “Exhaust (B6),” “O2 In (B2),” and “O2 Out (B5)” to the new Agent Bench assembly.

Safety Tests

Replacement or repair of the boards or modules requires Hi-Pot and Leakage testing. See “Main Monitor Maintenance and Checkout” in Section 2 for full test procedures.

Servicing the ECG Module

The ECG Module is not field servicable. Return the ECG Module to MEDRAD for service or replacement.

Servicing the Power Supply

⚠DANGER⚠

- High Voltage! Repairing and testing the power supply requires working with dangerous voltages. The power supply module should only be serviced by experienced electrical repair technicians.

The external power supply is not field servicable. Return the power supply to MEDRAD for service or replacement.

6 *Main Monitor BOMs and Drawings*

List of Drawings	Title	Drawing Number
Assembly BOMs and Drawings	Monitor Final Assembly Drawing	3010947
	Monitor Final Assemblies	
	Base	3010455
	BasePlus	3010723
	Cardiac	3010457
	Cardiac With Temperature	3010843
	Anesthesia	3010458
	Anesthesia with Temperature	3010841
	Base Assembly	
	With Gas	3010672
	Without Gas	3010982
	Post Assembly	3010764
	Main Top Assembly	
	Base	3010977
	BasePlus	3010978
	Cardiac	3010979
	Cardiac With Temperature	3010980
	Anesthesia	3010981
	Anesthesia with Temperature	3010946
	Enclosure Rear Top Unit Assembly	3010772
	Charger Board Assembly	3010668
	NIBP Chassis Assembly	3011486
	Battery Assembly	3011506

Monitor Final Assemblies

Base Monitor 3010620 MR COMP MON BASIC SYSTEM

Item #	Part Number	Description
01	3010982	BASE AY MAIN NO GAS
02	3010764	POST ASSEMBLY
03	3010977	TOP AY MAIN BASE
04	3010770	FLANGE TOP MAIN UNIT
06	3010744	COVER COSMETIC
07	3010745	COVER SMALL COSMETIC
08	3010948	TRAY OBSERVER
09	3010967	COLLAR TOP TRAY

BasePlus Monitor 3010723 MR COMP MON BASIC+SYSTEM

Item #	Part Number	Description
01	3010982	BASE AY MAIN NO GAS
02	3010764	POST ASSEMBLY
03	3010978	TOP AY MAIN BASE COMM
04	3010770	FLANGE TOP MAIN UNIT
06	3010744	COVER COSMETIC
07	3010745	COVER SMALL COSMETIC
08	3010948	TRAY OBSERVER
09	3010967	COLLAR TOP TRAY

Cardiac Monitor 3010621 MR COMP MONITOR CARDIAC

Item #	Part Number	Description
01	3010982	BASE AY MAIN NO GAS
02	3010764	POST ASSEMBLY
03	3010979	TOP AY MAIN C-NO TEMP
04	3010770	FLANGE TOP MAIN UNIT
06	3010744	COVER COSMETIC
07	3010745	COVER SMALL COSMETIC
08	3010948	TRAY OBSERVER
09	3010967	COLLAR TOP TRAY

Cardiac with Temperature Monitor 3010844 MR COMP MONITOR CARDIAC

Item #	Part Number	Description
01	3010982	BASE AY MAIN NO GAS
02	3010764	POST ASSEMBLY
03	3010980	TOP AY MAIN C-W/TEMP
04	3010770	FLANGE TOP MAIN UNIT
06	3010744	COVER COSMETIC
07	3010745	COVER SMALL COSMETIC
08	3010948	TRAY OBSERVER
09	3010967	COLLAR TOP TRAY

Anesthetic Monitor 3010622 MR COMP MON ANESTHESIA

Item #	Part Number	Description
01	3010672	BASE AY MAIN W/ GAS
02	3010764	POST ASSEMBLY
03	3010981	TOP AY MAIN A-NO TEMP
04	3010770	FLANGE TOP MAIN UNIT
06	3010744	COVER COSMETIC
07	3010745	COVER SMALL COSMETIC
08	3010948	TRAY OBSERVER
09	3010967	COLLAR TOP TRAY

Anesthetic with Temperature Monitor 3010842 MR COMP MON ANESTHESIA

Item #	Part Number	Description
01	3010672	BASE AY MAIN W/ GAS
02	3010764	POST ASSEMBLY
03	3010946	TOP AY MAIN A-W/TEMP
04	3010770	FLANGE TOP MAIN UNIT
06	3010744	COVER COSMETIC
07	3010745	COVER SMALL COSMETIC
08	3010948	TRAY OBSERVER
09	3010967	COLLAR TOP TRAY

Base Assemblies

Base Assembly without Gas 3010982 BASE AY MAIN NO GAS

Item #	Part Number	Description
01	3010673	HOUSING BASE
02	3010674	COVER BASE MAIN
03	3011506	BATTERY AY W/ CABLE
04	3010668	PCB CHARGER ASSEMBLY
06	3010676	PLATE CONNECTORS BASE AY
07	3010682	PLATE POWER INPUT AY
12	3011486	CHASSIS NIBP AY
13	3006523	CASTER ROLL RESISTANT
14	3006524	CASTER WITH BRAKE
19	3011485	GASKET ROUND MESH
37	3010975	LBL SET BASE AY, ENGLISH
	3012459	LBL SET BASE AY, FRENCH
	3012460	LBL SET BASE AY, GERMAN
	3012471	LBL SET BASE AY, JAPANESE
	3012472	LBL SET BASE AY, SPANISH
	3012473	LBL SET BASE AY, PORTUGUESE
	3012474	LBL SET BASE AY, ITALIAN
	3012475	LBL SET BASE AY, SWEDISH
	3012476	LBL SET BASE AY, DUTCH

Base Assembly with Gas 3010672 BASE AY MAIN W/ GAS

Item #	Part Number	Description
01	3010673	HOUSING BASE
02	3010674	COVER BASE MAIN
03	3011506	BATTERY AY W/ CABLE
04	3010668	PCB CHARGER ASSEMBLY
05	3010691	IBENCH WITH MOUNTING AY
06	3010676	PLATE CONNECTORS BASE AY
07	3010682	PLATE POWER INPUT AY
12	3011486	CHASSIS NIBP AY
13	3006523	CASTER ROLL RESISTANT
14	3006524	CASTER WITH BRAKE
19	3011485	GASKET ROUND MESH
37	3010975	LBL SET BASE AY, ENGLISH
	3012459	LBL SET BASE AY, FRENCH
	3012460	LBL SET BASE AY, GERMAN
	3012471	LBL SET BASE AY, JAPANESE
	3012472	LBL SET BASE AY, SPANISH
	3012473	LBL SET BASE AY, PORTUGUESE
	3012474	LBL SET BASE AY, ITALIAN
	3012475	LBL SET BASE AY, SWEDISH
	3012476	LBL SET BASE AY, DUTCH
40	3010730	CHASSIS O2 AY

Main Top Assemblies

Base 3010977 TOP AY MAIN BASE

Item #	Part Number	Description
04	3010641	VERIS MAIN UNIT MAIN BRD
05	3010652	AY PCB VSM BOARD
06	3010662	AY PCB ECG-DSP BOARD
16	3011485	GASKET ROUND MESH .125 FT
34	3011567	CABLE F-O DUPLEX STR-THRU
35	3010963	LBL SET TOP UNIT, ENGLISH
	3012477	LBL SET TOP UNIT, FRENCH
	3012478	LBL SET TOP UNIT, GERMAN
	3012479	LBL SET TOP UNIT, JAPANESE
	3012480	LBL SET TOP UNIT, SPANISH
	3012481	LBL SET TOP UNIT, PORTUGUESE
	3012482	LBL SET TOP UNIT, ITALIAN
	3012483	LBL SET TOP UNIT, SWEDISH
	3012484	LBL SET TOP UNIT, DUTCH

BasePlus 3010978 TOP AY MAIN BASE COMM

Item #	Part Number	Description
04	3010641	VERIS MAIN UNIT MAIN BRD
05	3010652	AY PCB VSM BOARD
06	3010662	AY PCB ECG-DSP BOARD
13	3010973	DPAC COMMUNICATIONS BRD
16	3011485	GASKET ROUND MESH .125 FT
34	3011567	CABLE F-O DUPLEX STR-THRU
35	3010963	LBL SET TOP UNIT, ENGLISH
	3012477	LBL SET TOP UNIT, FRENCH
	3012478	LBL SET TOP UNIT, GERMAN
	3012479	LBL SET TOP UNIT, JAPANESE
	3012480	LBL SET TOP UNIT, SPANISH
	3012481	LBL SET TOP UNIT, PORTUGUESE
	3012482	LBL SET TOP UNIT, ITALIAN
	3012483	LBL SET TOP UNIT, SWEDISH
	3012484	LBL SET TOP UNIT, DUTCH
47	3011476	FO INT COMM DUPLX CBL
48	3011499	ST SPLICE BUSHING

Cardiac 3010979 TOP AY MAIN C-NO TEMP

Item #	Part Number	Description
04	3010641	VERIS MAIN UNIT MAIN BRD
05	3010652	AY PCB VSM BOARD
06	3010662	AY PCB ECG-DSP BOARD
07	3011533	VERIS IBP PCB ASSY
13	3010973	DPAC COMMUNICATIONS BRD
16	3011485	GASKET ROUND MESH .125 FT
34	3011567	CABLE F-O DUPLEX STR-THRU
35	3010963	LBL SET TOP UNIT, ENGLISH
	3012477	LBL SET TOP UNIT, FRENCH
	3012478	LBL SET TOP UNIT, GERMAN
	3012479	LBL SET TOP UNIT, JAPANESE
	3012480	LBL SET TOP UNIT, SPANISH
	3012481	LBL SET TOP UNIT, PORTUGUESE
	3012482	LBL SET TOP UNIT, ITALIAN
	3012483	LBL SET TOP UNIT, SWEDISH
	3012484	LBL SET TOP UNIT, DUTCH
47	3011476	FO INT COMM DUPLX CBL
48	3011499	ST SPLICE BUSHING

Cardiac with Temperature 3010980 TOP AY MAIN C-W/TEMP

Item #	Part Number	Description
04	3010641	VERIS MAIN UNIT MAIN BRD
05	3010652	AY PCB VSM BOARD
06	3010662	AY PCB ECG-DSP BOARD
07	3011533	VERIS IBP PCB ASSY
08	3010986	TEMP MODULE W/MOUNT
13	3010973	DPAC COMMUNICATIONS BRD
16	3011485	GASKET ROUND MESH .125 FT
34	3011567	CABLE F-O DUPLEX STR-THRU
35	3010963	LBL SET TOP UNIT, ENGLISH
	3012477	LBL SET TOP UNIT, FRENCH
	3012478	LBL SET TOP UNIT, GERMAN
	3012479	LBL SET TOP UNIT, JAPANESE
	3012480	LBL SET TOP UNIT, SPANISH
	3012481	LBL SET TOP UNIT, PORTUGUESE
	3012482	LBL SET TOP UNIT, ITALIAN
	3012483	LBL SET TOP UNIT, SWEDISH
	3012484	LBL SET TOP UNIT, DUTCH
47	3011476	FO INT COMM DUPLX CBL
48	3011499	ST SPLICE BUSHING

Anesthesia 3010981 TOP AY MAIN A-NO TEMP

Item #	Part Number	Description
04	3010641	VERIS MAIN UNIT MAIN BRD
05	3010652	AY PCB VSM BOARD
06	3010662	AY PCB ECG-DSP BOARD
07	3011533	VERIS IBP PCB ASSY
13	3010973	DPAC COMMUNICATIONS BRD
16	3011485	GASKET ROUND MESH .125 FT
34	3011567	CABLE F-O DUPLEX STR-THRU
35	3010963	LBL SET TOP UNIT, ENGLISH
	3012477	LBL SET TOP UNIT, FRENCH
	3012478	LBL SET TOP UNIT, GERMAN
	3012479	LBL SET TOP UNIT, JAPANESE
	3012480	LBL SET TOP UNIT, SPANISH
	3012481	LBL SET TOP UNIT, PORTUGUESE
	3012482	LBL SET TOP UNIT, ITALIAN
	3012483	LBL SET TOP UNIT, SWEDISH
	3012484	LBL SET TOP UNIT, DUTCH
47	3011476	FO INT COMM DUPLX CBL
48	3011499	ST SPLICE BUSHING

Anesthesia with Temperature 3010946 TOP AY MAIN A-W/TEMP

Item #	Part Number	Description
04	3010641	VERIS MAIN UNIT MAIN BRD
05	3010652	AY PCB VSM BOARD
06	3010662	AY PCB ECG-DSP BOARD
07	3011533	VERIS IBP PCB ASSY
08	3010986	TEMP MODULE W/MOUNT
13	3010973	DPAC COMMUNICATIONS BRD
16	3011485	GASKET ROUND MESH .125 FT
34	3011567	CABLE F-O DUPLEX STR-THRU
35	3010963	LBL SET TOP UNIT, ENGLISH
	3012477	LBL SET TOP UNIT, FRENCH
	3012478	LBL SET TOP UNIT, GERMAN
	3012479	LBL SET TOP UNIT, JAPANESE
	3012480	LBL SET TOP UNIT, SPANISH
	3012481	LBL SET TOP UNIT, PORTUGUESE
	3012482	LBL SET TOP UNIT, ITALIAN
	3012483	LBL SET TOP UNIT, SWEDISH
	3012484	LBL SET TOP UNIT, DUTCH
47	3011476	FO INT COMM DUPLX CBL
48	3011499	ST SPLICE BUSHING

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2:12:00. The signed original is maintained in
o confirm this copy's revision is the latest released.
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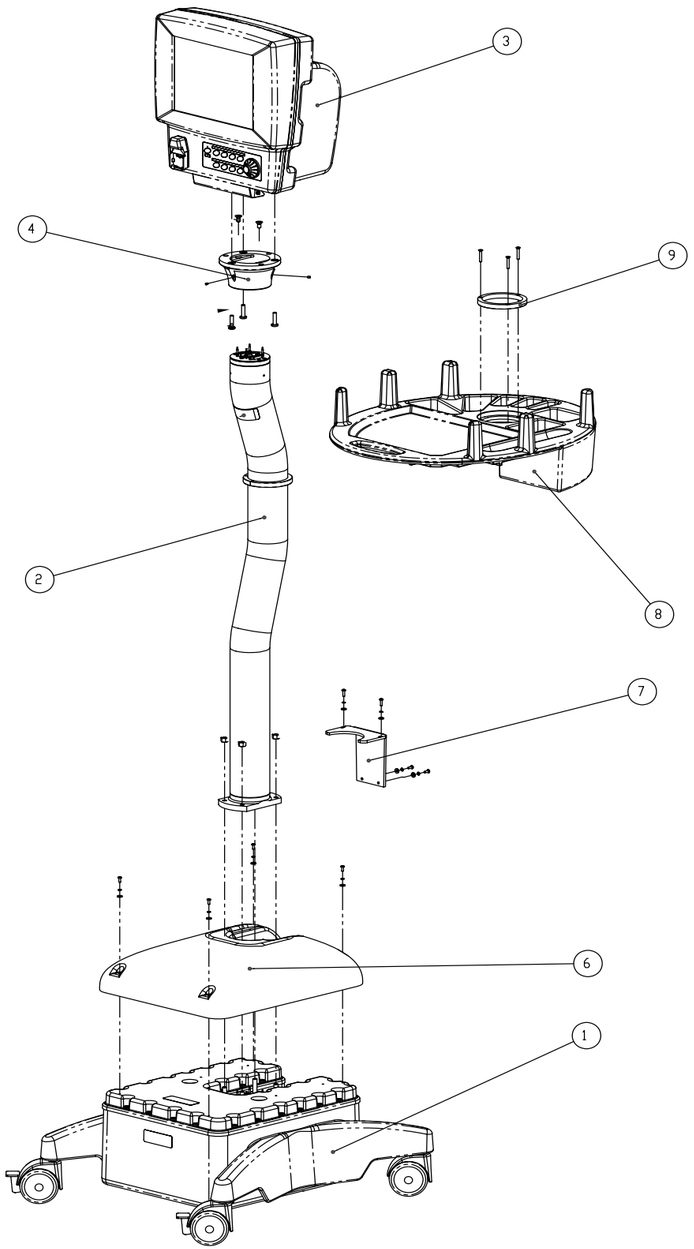
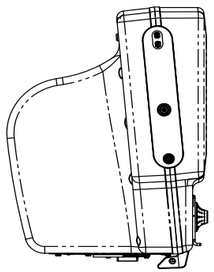
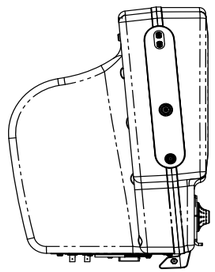
Monitor Final Assembly
(3010947)

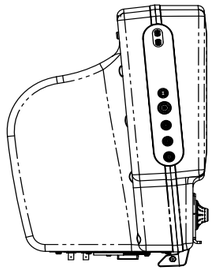




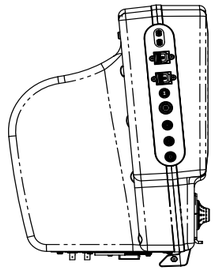
VIEW 1
LEFT VIEW OF
ITEM 3



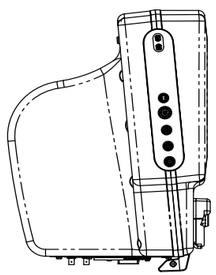
VIEW 2
LEFT VIEW OF
ITEM 3



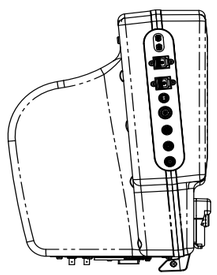
VIEW 3
LEFT VIEW OF
ITEM 3



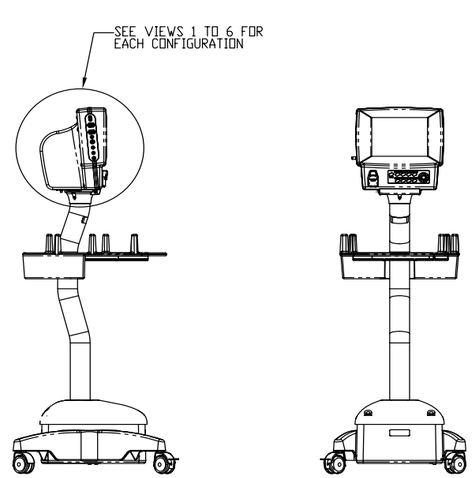
VIEW 4
LEFT VIEW OF
ITEM 3



VIEW 5
LEFT VIEW OF
ITEM 3



VIEW 6
LEFT VIEW OF
ITEM 3



MAIN ASSEMBLY PART NUMBER	DESCRIPTION	ITEM 1 PART NUMBER	ITEM 3 PART NUMBER	VIEW NO.
3010620	MR COMP MONITOR BASIC SYSTEM	3010982	3010977	1
3010724	MR COMP MONITOR BASIC + SYSTEM	3010982	3010978	2
3010621	MR COMP MONITOR CARDIAC	3010982	3010979	3
3010844	MR COMP MONITOR CARDIAC W/TEMP	3010982	3010980	4
3010622	MR COMP MONITOR ANETHSESIA	3010672	3010981	5
3010842	MR COMP MONITOR ANESTHESIA W/TEMP	3010672	3010946	6

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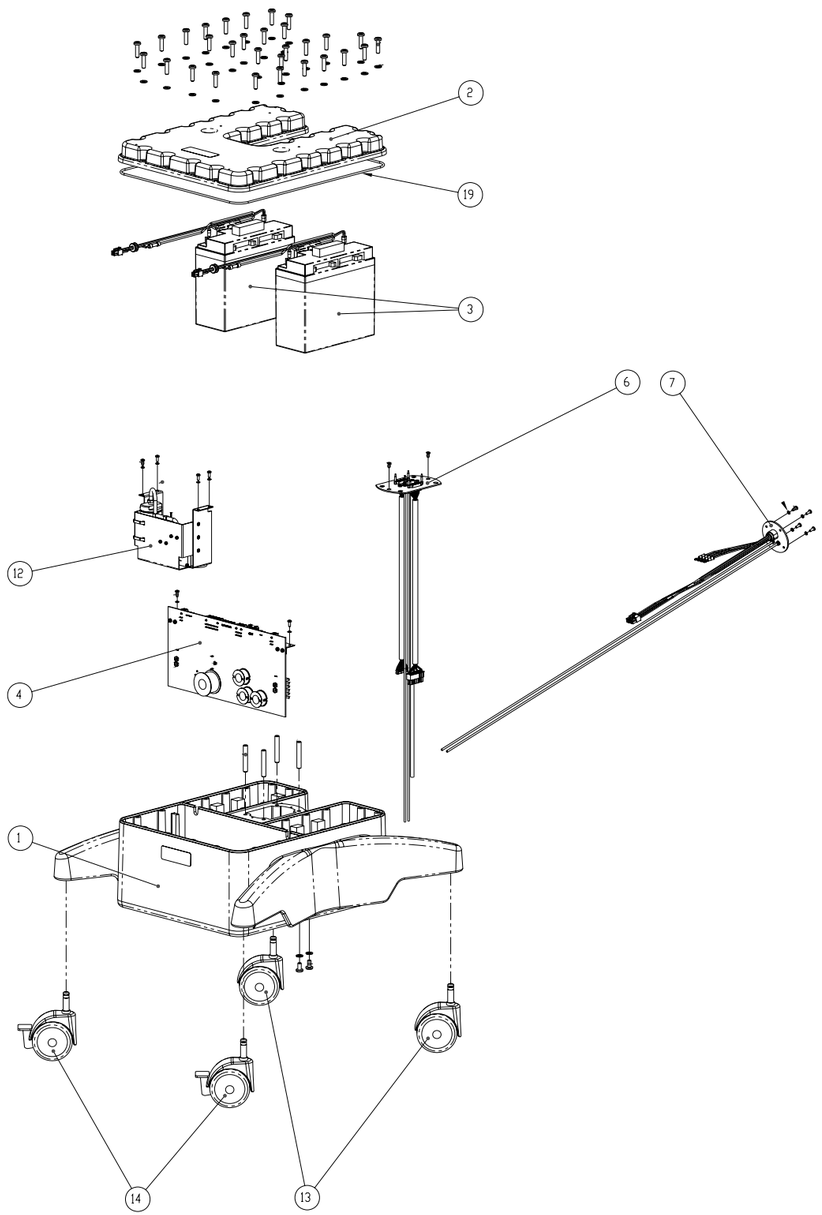
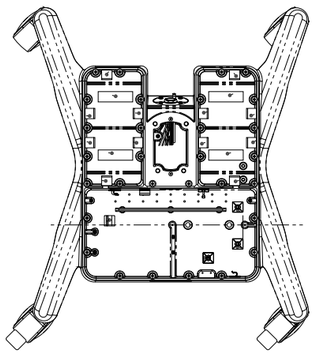
Base Assemblies

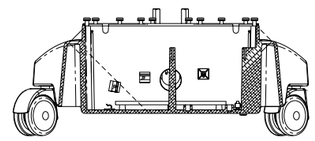
Base Assembly--No Gas
(3010982)



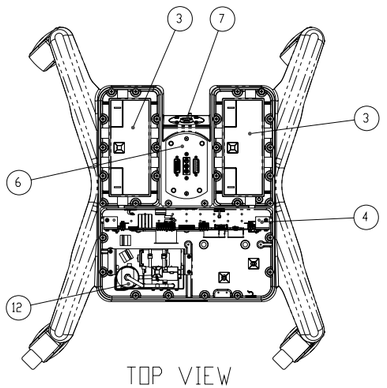


TOP VIEW

ITEMS 2, 3, 4, 6, AND 12 ARE NOT SHOWN FOR CLARITY

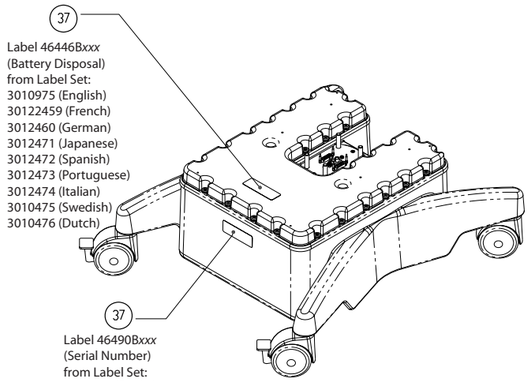


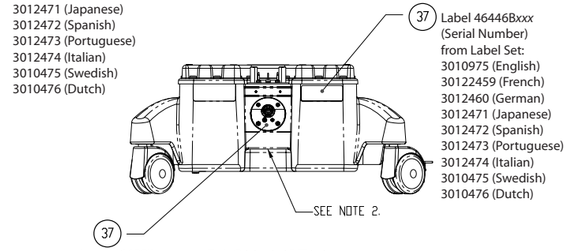
SECTION A-A



TOP VIEW

ITEM 2 NOT SHOWN FOR CLARITY





BACK VIEW

NOTES:

1. USE 3010982P ASSEMBLY PROCEDURE.

2. ATTACH LABEL WITH "3010982" AND SERIAL NUMBER FOR THE BASE ASSEMBLY INSIDE THE CAVITY (NOT IN PLAIN SIGHT).

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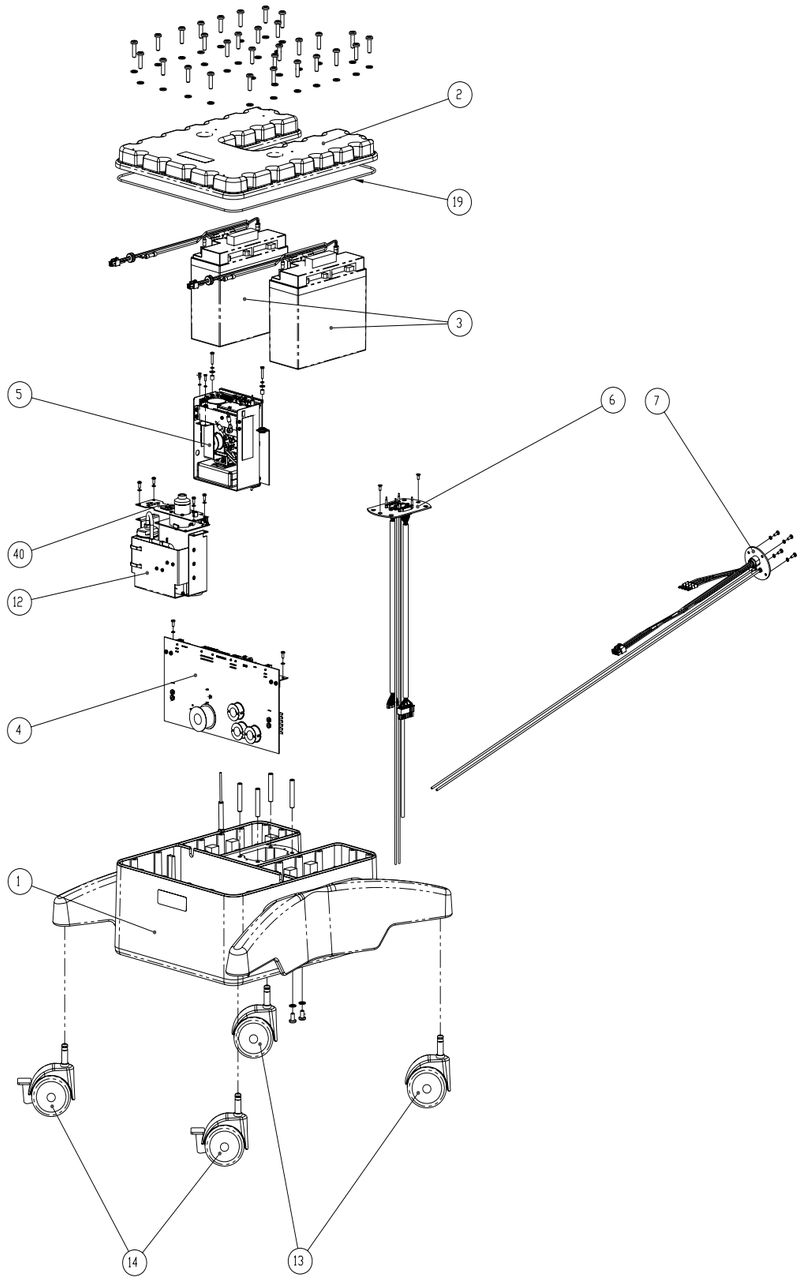
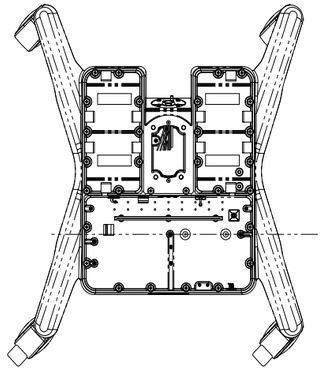
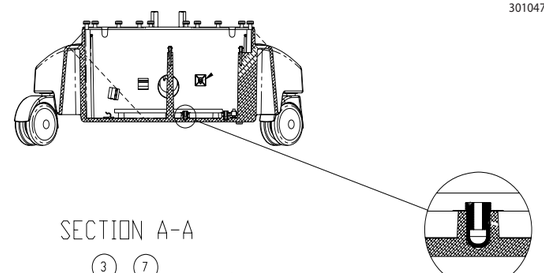
Base Assembly--With Gas
(3010672)





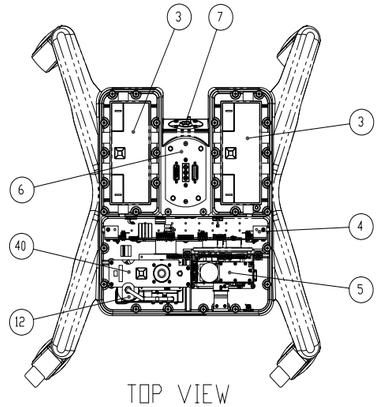
TOP VIEW

ITEMS 2, 3, 4, 5, 6 12 AND 40 ARE NOT SHOWN FOR CLARITY



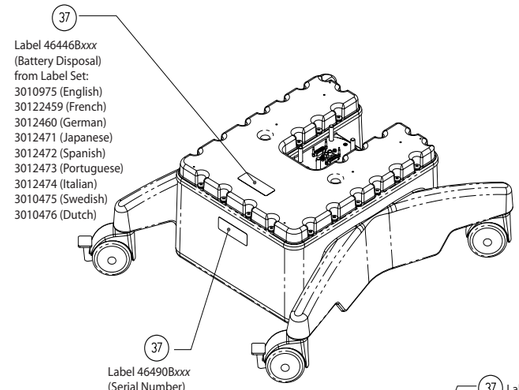
SECTION A-A

DETAIL B
SCALE 1 : 1



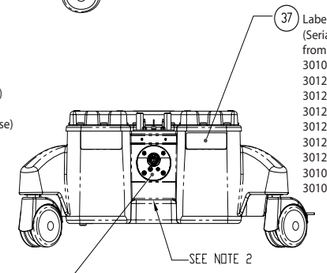
TOP VIEW

ITEM 2 NOT SHOWN FOR CLARITY



Label 46446B*xxx*
(Battery Disposal)
from Label Set:
3010975 (English)
30122459 (French)
3012460 (German)
3012471 (Japanese)
3012472 (Spanish)
3012473 (Portuguese)
3012474 (Italian)
3010475 (Swedish)
3010476 (Dutch)

Label 46490B*xxx*
(Serial Number)
from Label Set:
3010975 (English)
30122459 (French)
3012460 (German)
3012471 (Japanese)
3012472 (Spanish)
3012473 (Portuguese)
3012474 (Italian)
3010475 (Swedish)
3010476 (Dutch)



Label 46446B*xxx*
(Serial Number)
from Label Set:
3010975 (English)
30122459 (French)
3012460 (German)
3012471 (Japanese)
3012472 (Spanish)
3012473 (Portuguese)
3012474 (Italian)
3010475 (Swedish)
3010476 (Dutch)

37 BACK VIEW

Label 46429B*xxx*
(DC Rating)
from Label Set:
3010975 (English)
30122459 (French)
3012460 (German)
3012471 (Japanese)
3012472 (Spanish)
3012473 (Portuguese)
3012474 (Italian)
3010475 (Swedish)
3010476 (Dutch)

NOTES:

1. USE 3010672P ASSEMBLY PROCEDURE.

2. ATTACH LABEL WITH "3010672" AND SERIAL NUMBER FOR THE BASE ASSEMBLY INSIDE THE CAVITY (NOT IN PLAIN SIGHT).

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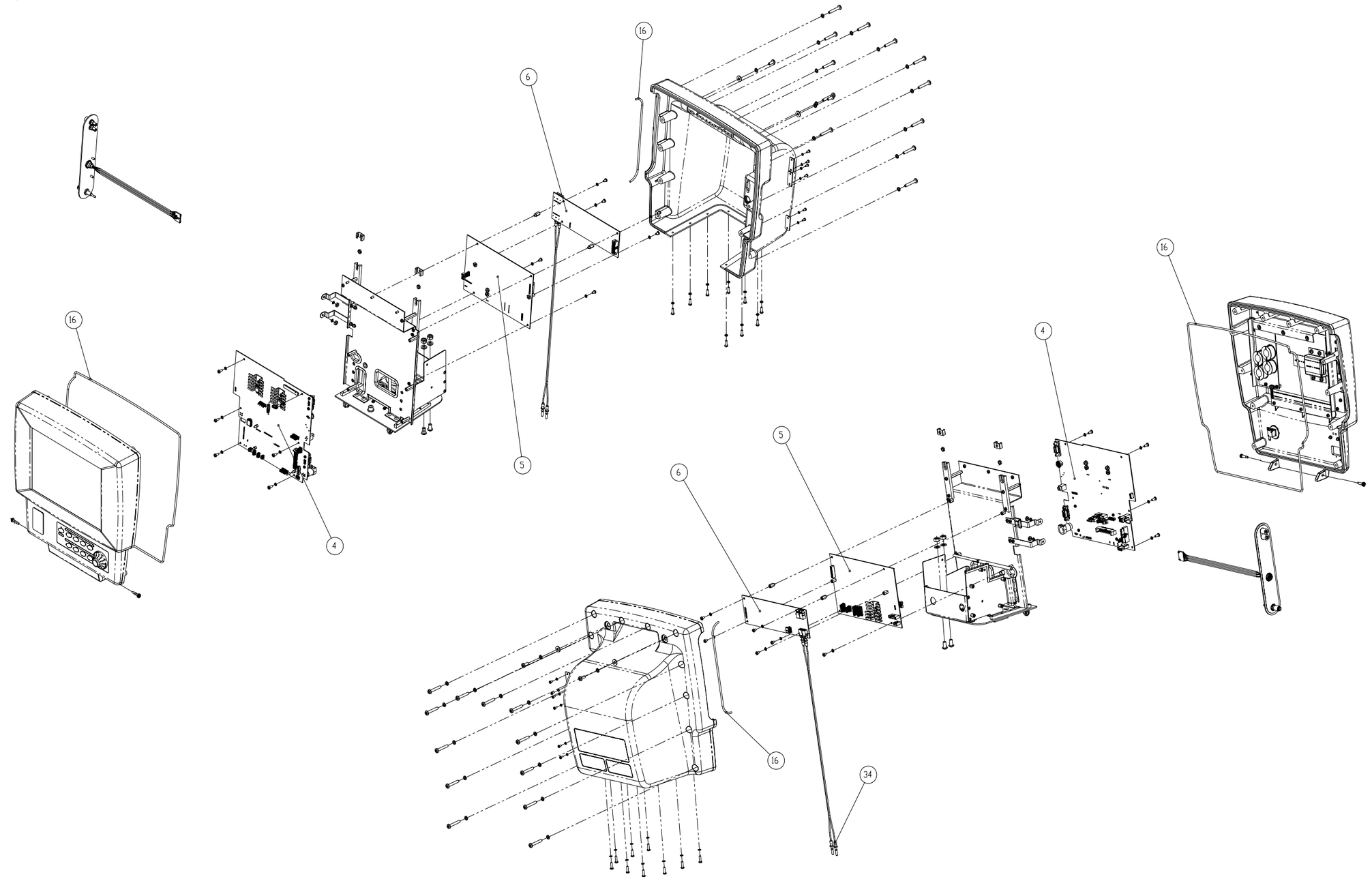
Main Top Assembly

Base (3010977)



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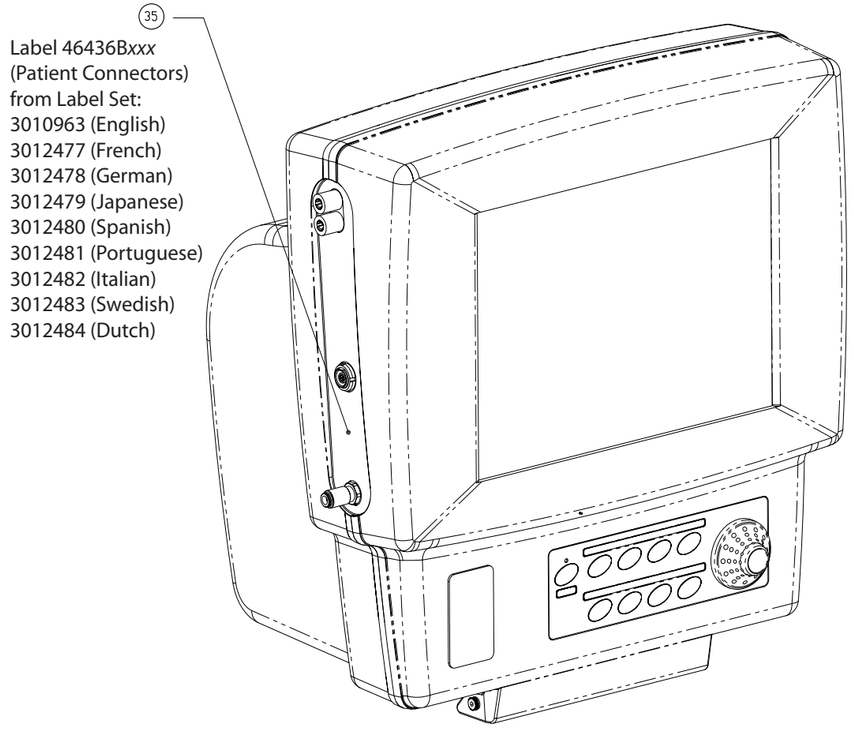

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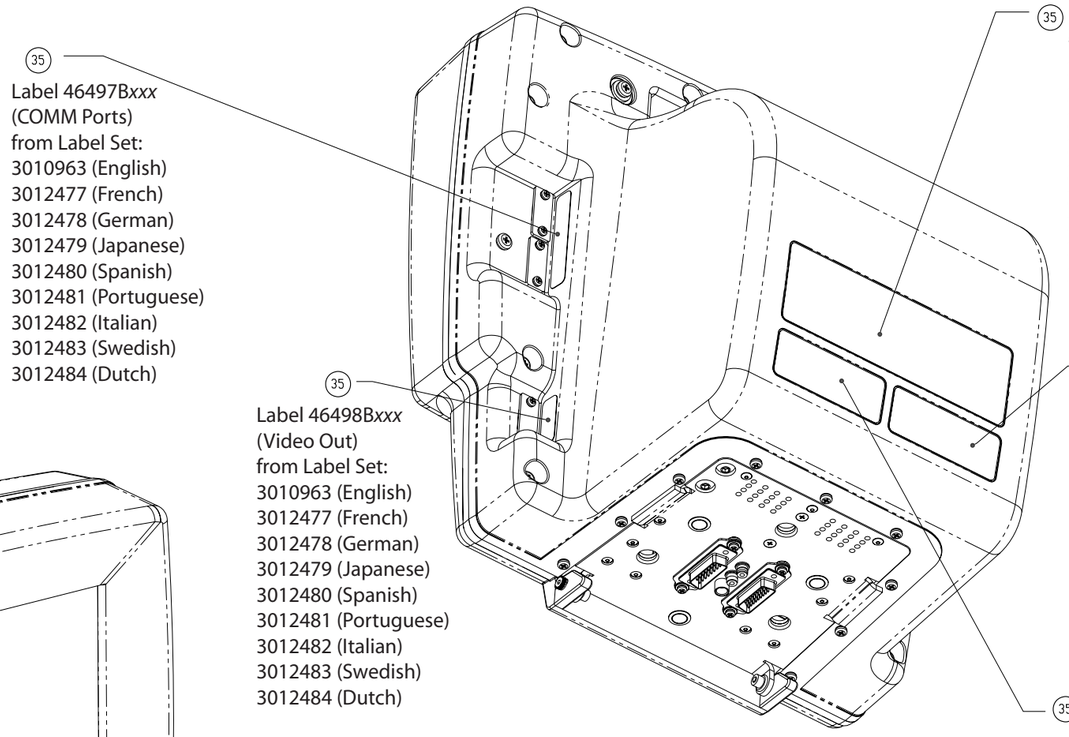

SCALE 1 : 2

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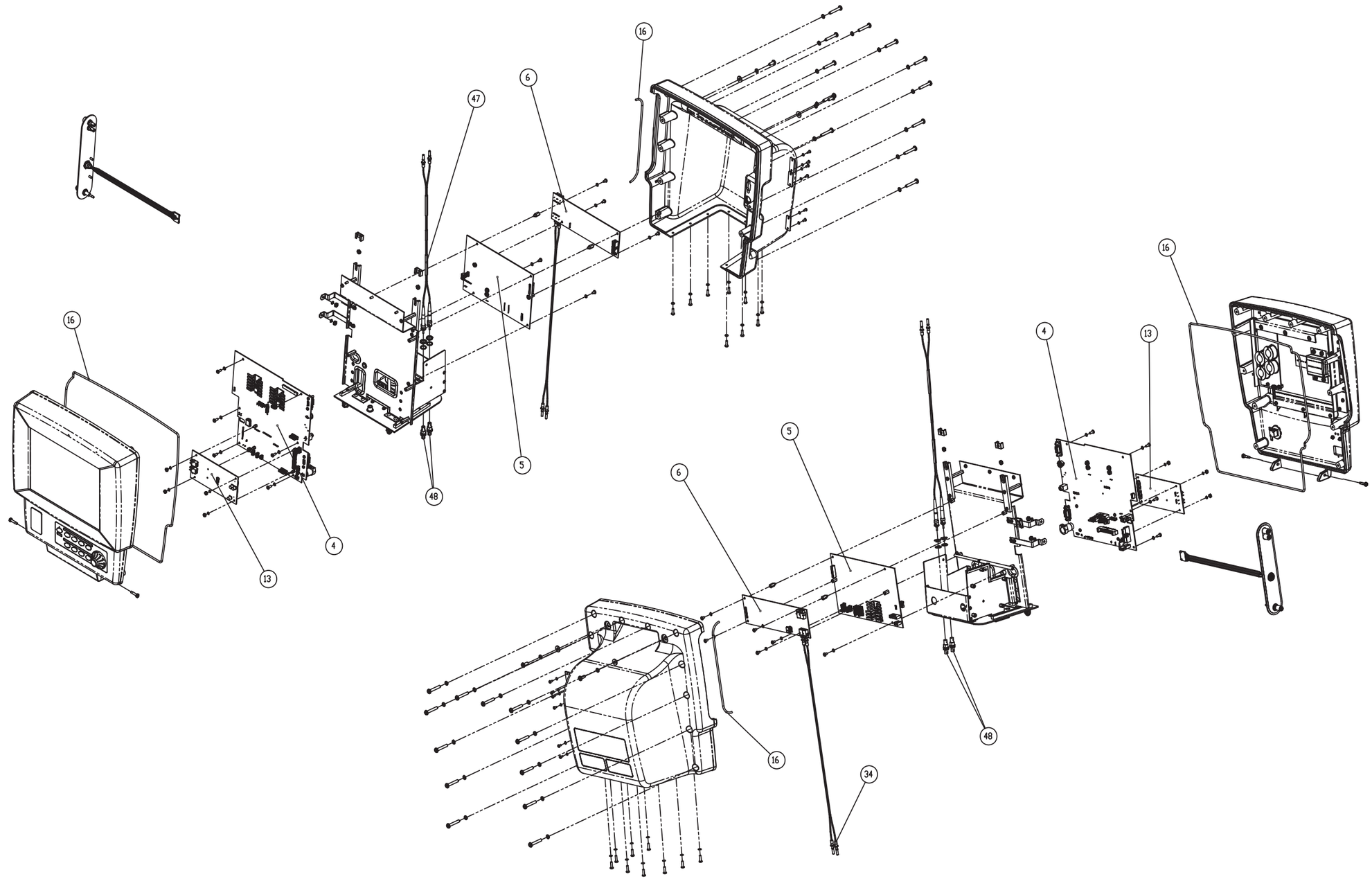
BasePlus (3010978)



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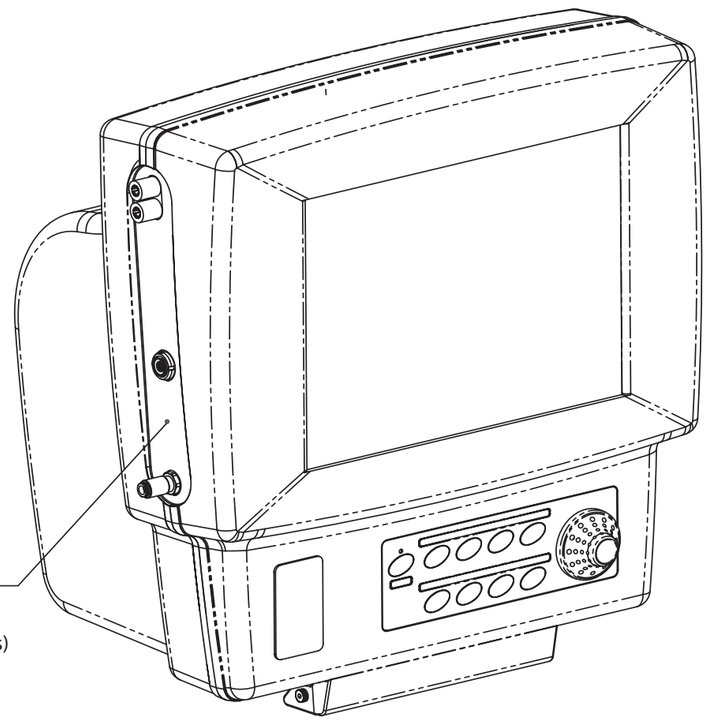

35 Label 46436B*xxx*
(Patient Connectors)
from Label Set:
3010963 (English)
3012477 (French)
3012478 (German)
3012479 (Japanese)
3012480 (Spanish)
3012481 (Portuguese)
3012482 (Italian)
3012483 (Swedish)
3012484 (Dutch)

SCALE 1 : 2

35 Label 46497B*xxx*
(COMM Ports)
from Label Set:
3010963 (English)
3012477 (French)
3012478 (German)
3012479 (Japanese)
3012480 (Spanish)
3012481 (Portuguese)
3012482 (Italian)
3012483 (Swedish)
3012484 (Dutch)

35 Label 46498B*xxx*
(Video Out)
from Label Set:
3010963 (English)
3012477 (French)
3012478 (German)
3012479 (Japanese)
3012480 (Spanish)
3012481 (Portuguese)
3012482 (Italian)
3012483 (Swedish)
3012484 (Dutch)

35 Label 46499B*xxx*
(Video Out)
from Label Set:
3010963 (English)
3012477 (French)
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3012479 (Japanese)
3012480 (Spanish)
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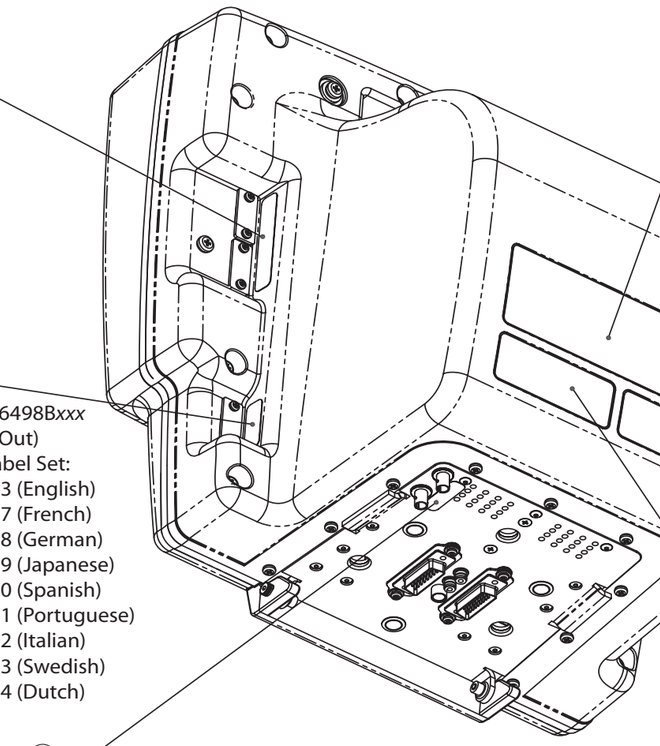

SCALE 1 : 2

35 Label 46434B*xxx* (Warnings)
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3012478 (German)
3012479 (Japanese)
3012480 (Spanish)
3012481 (Portuguese)
3012482 (Italian)
3012483 (Swedish)
3012484 (Dutch)

35 Label 46443B*xxx*
(Serial Number)
from Label Set:
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3012477 (French)
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35 Label 46445B*xxx*
(FCC Label)
from Label Set:
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3012477 (French)
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3012481 (Portuguese)
3012482 (Italian)
3012483 (Swedish)
3012484 (Dutch)

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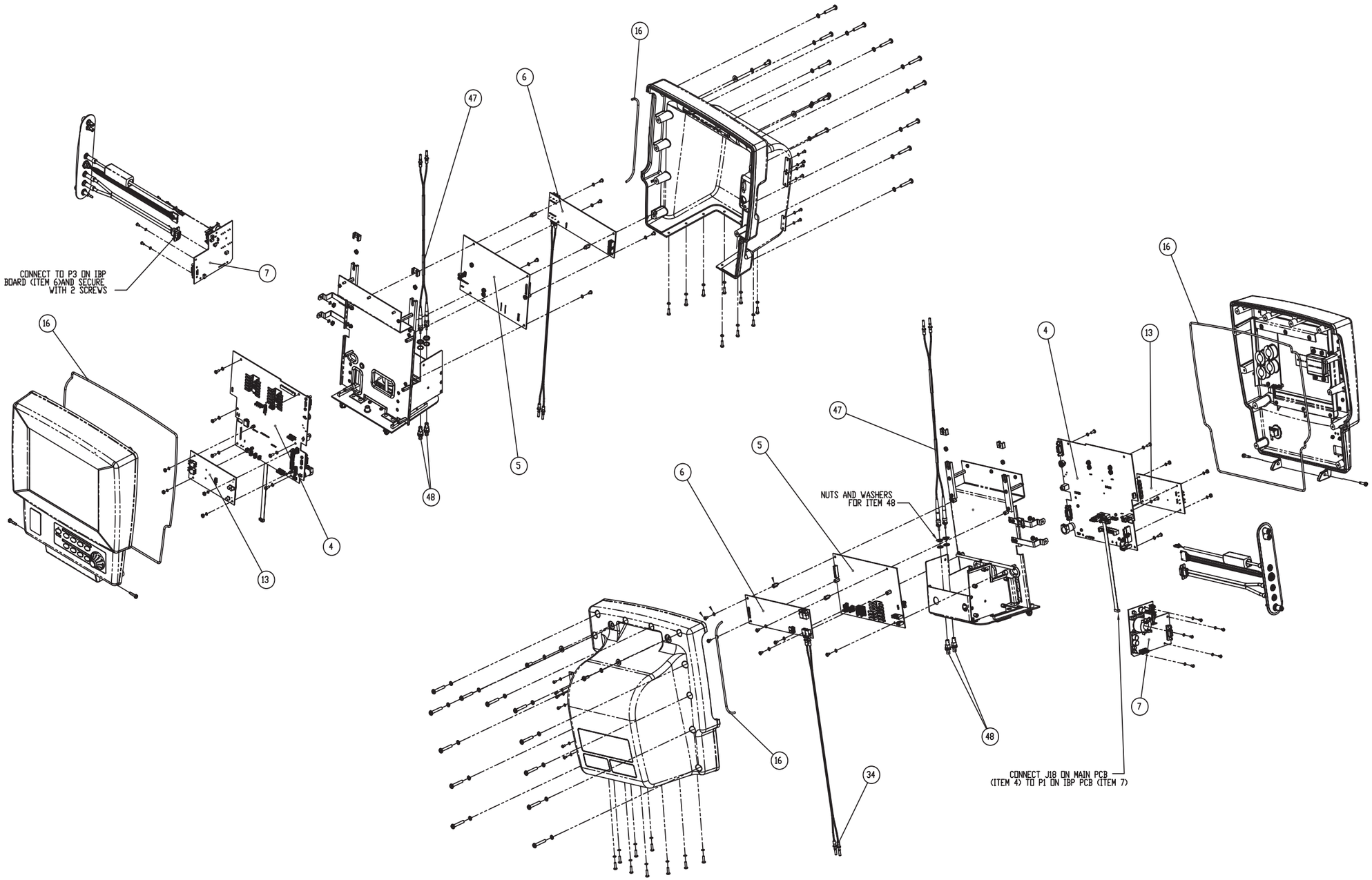
Cardiac (3010979)


CONNECT TO P3 ON IBP BOARD (ITEM 6) AND SECURE WITH 2 SCREWS
NUTS AND WASHERS FOR ITEM 48
CONNECT J18 ON MAIN PCB (ITEM 4) TO P1 ON IBP PCB (ITEM 7)

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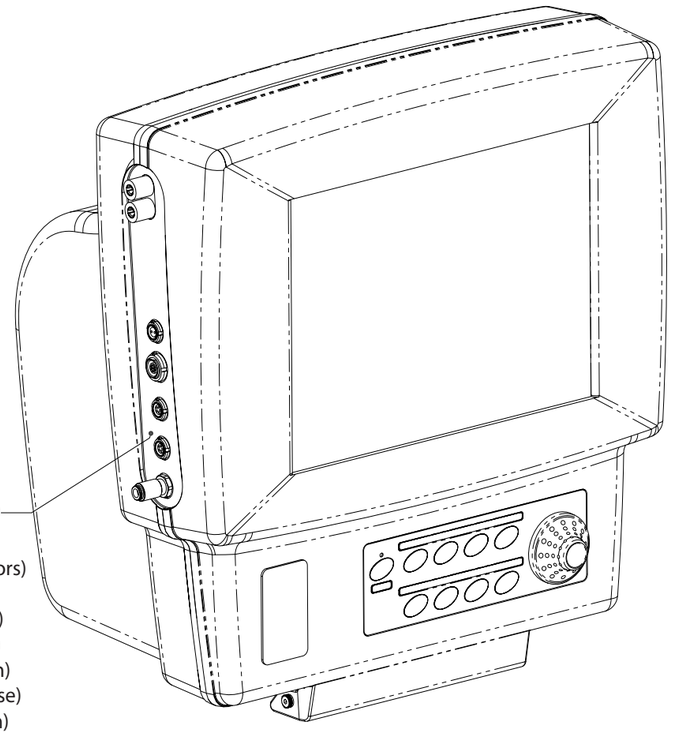

35 Label 46437B*xxx*
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from Label Set:
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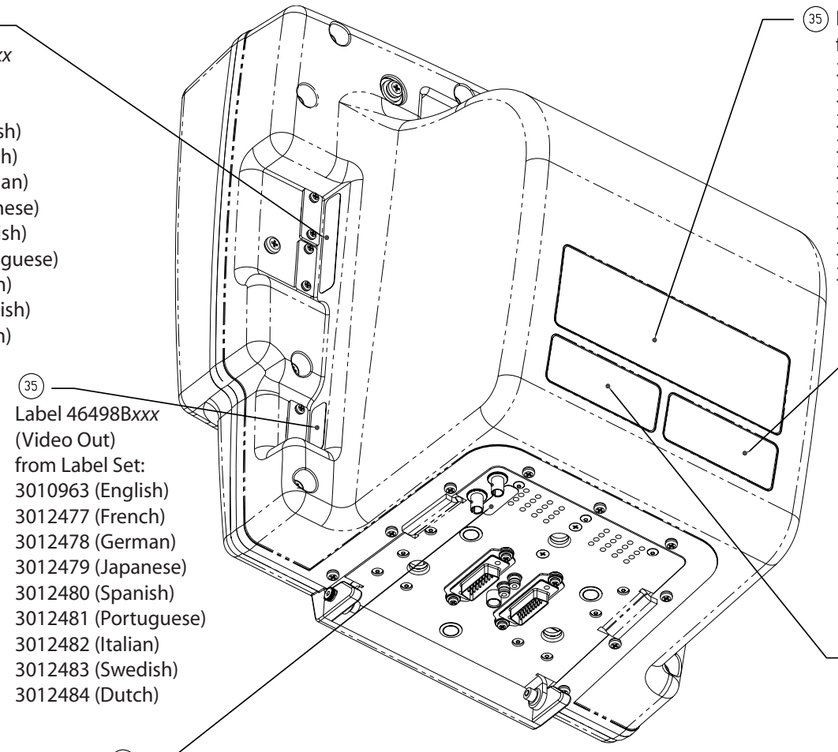
3012484 (Dutch)

SCALE 1 : 2



35 Label 46497B*xxx*
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3012479 (Japanese)
3012480 (Spanish)
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35 Label 46498B*xxx*
(Video Out)
from Label Set:
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3012477 (French)
3012478 (German)
3012479 (Japanese)
3012480 (Spanish)
3012481 (Portuguese)
3012482 (Italian)
3012483 (Swedish)
3012484 (Dutch)

35 Label 46499B*xxx*
(Video Out)
from Label Set:
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3012477 (French)
3012478 (German)
3012479 (Japanese)
3012480 (Spanish)
3012481 (Portuguese)
3012482 (Italian)
3012483 (Swedish)
3012484 (Dutch)

35 Label 46434B*xxx* (Warnings)
from Label Set:
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35 Label 46443B*xxx*
(Serial Number)
from Label Set:
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3012484 (Dutch)

35 Label 46445B*xxx*
(FCC Label)
from Label Set:
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3012479 (Japanese)
3012480 (Spanish)
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3012482 (Italian)
3012483 (Swedish)
3012484 (Dutch)

SCALE 1 : 2

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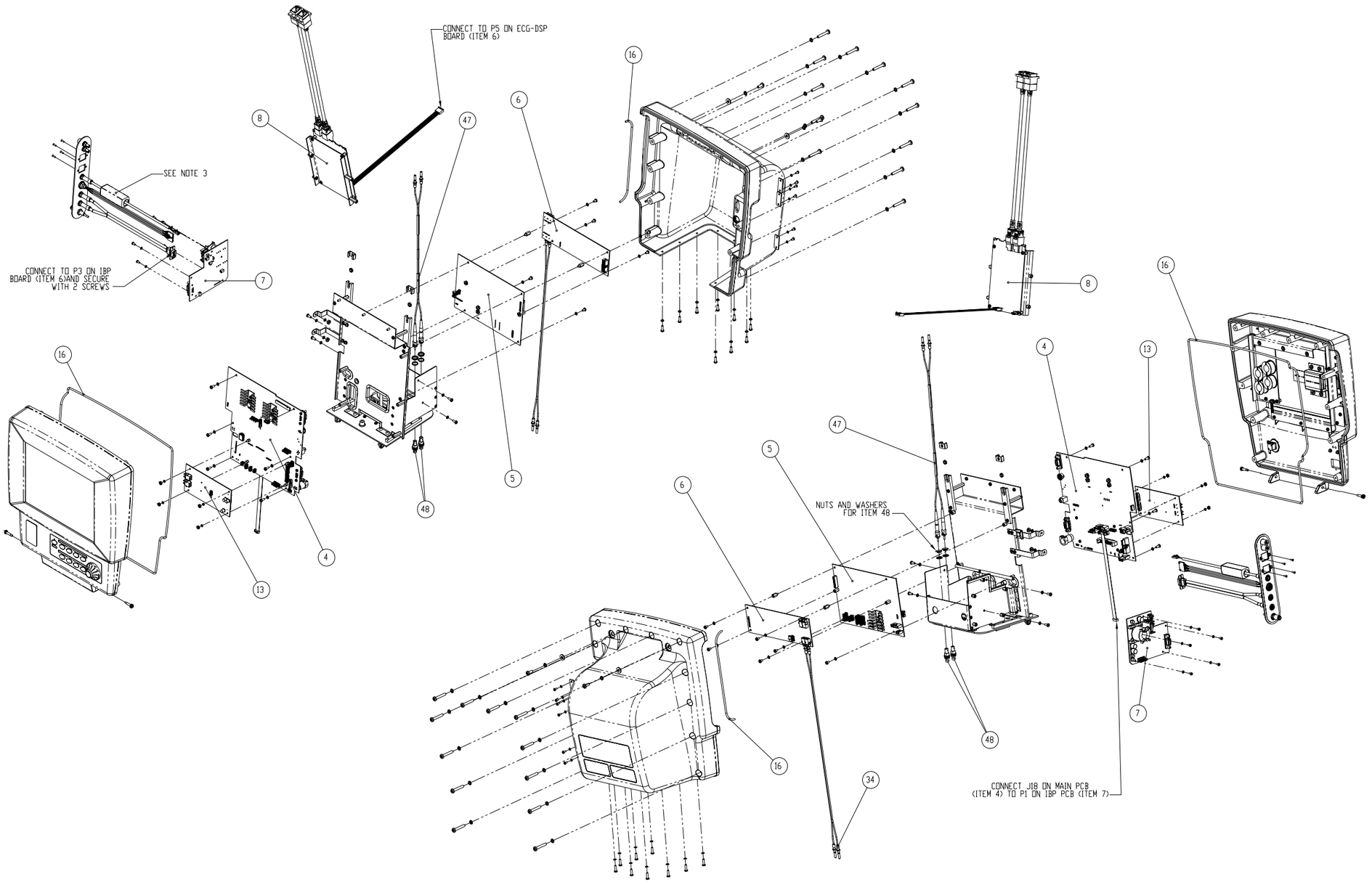
Cardiac With Temperature
(3010980)



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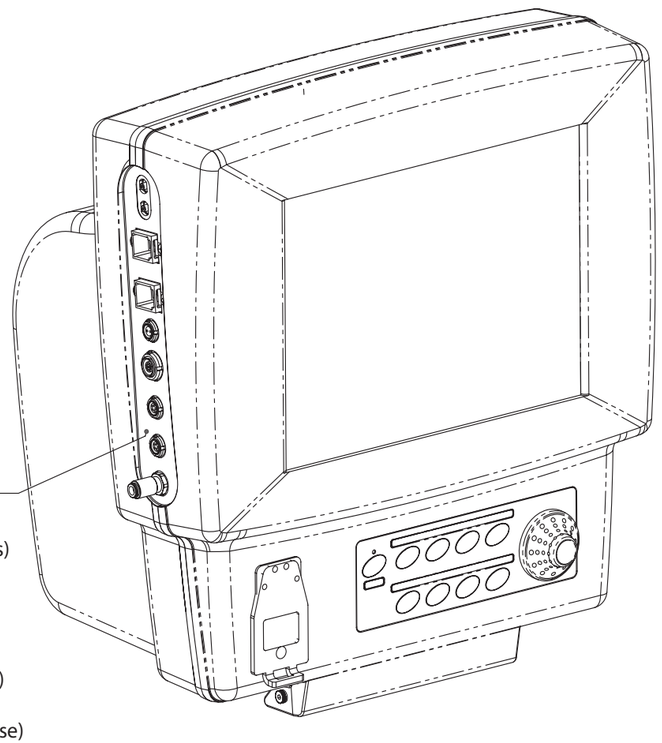

35 Label 46438B*xxx*
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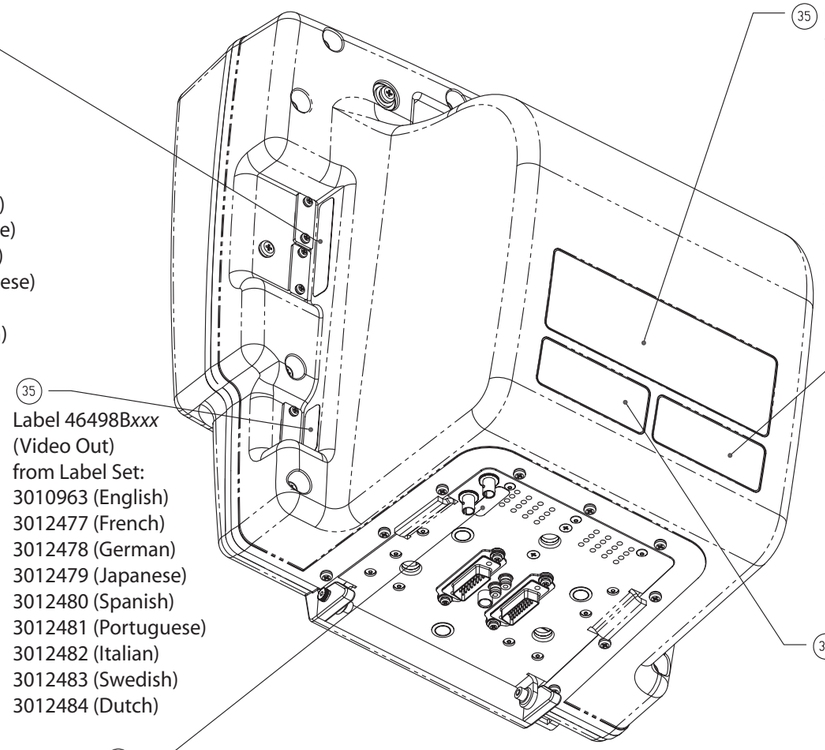
SCALE 1 : 2



35 Label 46497B*xxx*
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3012483 (Swedish)
3012484 (Dutch)

35 Label 46498B*xxx*
(Video Out)
from Label Set:
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3012477 (French)
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3012480 (Spanish)
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3012482 (Italian)
3012483 (Swedish)
3012484 (Dutch)

35 Label 46499B*xxx*
(Video Out)
from Label Set:
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3012478 (German)
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3012480 (Spanish)
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3012482 (Italian)
3012483 (Swedish)
3012484 (Dutch)

35 Label 46434B*xxx* (Warnings)
from Label Set:
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3012480 (Spanish)
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3012483 (Swedish)
3012484 (Dutch)

35 Label 46443B*xxx*
(Serial Number)
from Label Set:
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3012483 (Swedish)
3012484 (Dutch)

35 Label 46445B*xxx*
(FCC Label)
from Label Set:
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3012477 (French)
3012478 (German)
3012479 (Japanese)
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3012481 (Portuguese)
3012482 (Italian)
3012483 (Swedish)
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SCALE 1 : 2

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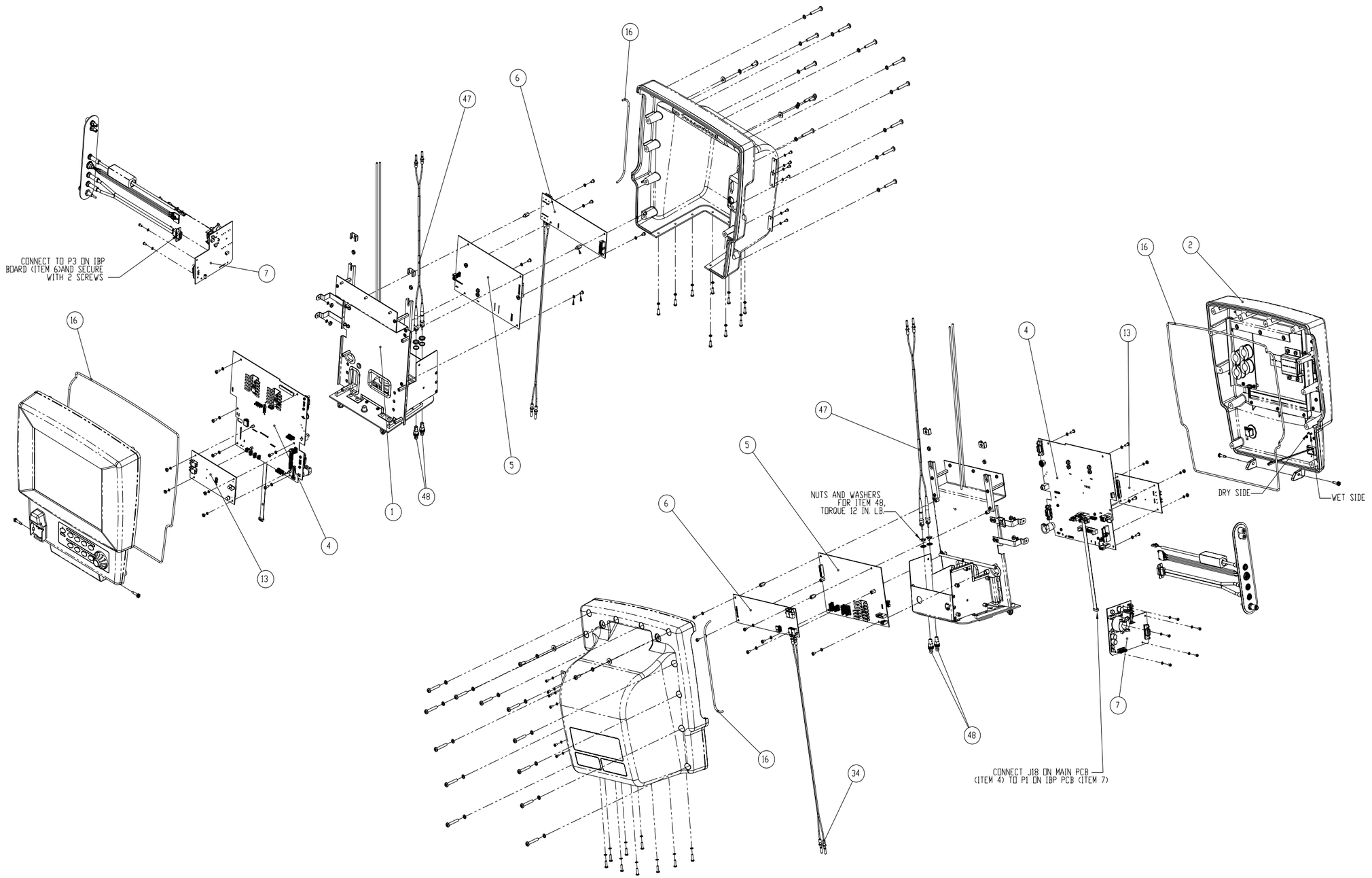
Anesthesia (3010981)


CONNECT TO P3 ON IBP BOARD (ITEM 6) AND SECURE WITH 2 SCREWS
NUTS AND WASHERS FOR ITEM 48, TORQUE 12 IN. LB.
CONNECT J18 ON MAIN PCB (ITEM 4) TO P1 ON IBP PCB (ITEM 7)
DRY SIDE
WET SIDE

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Documentation Systems. Prior to use, you are responsible to confirm this copy's revision is the latest released.
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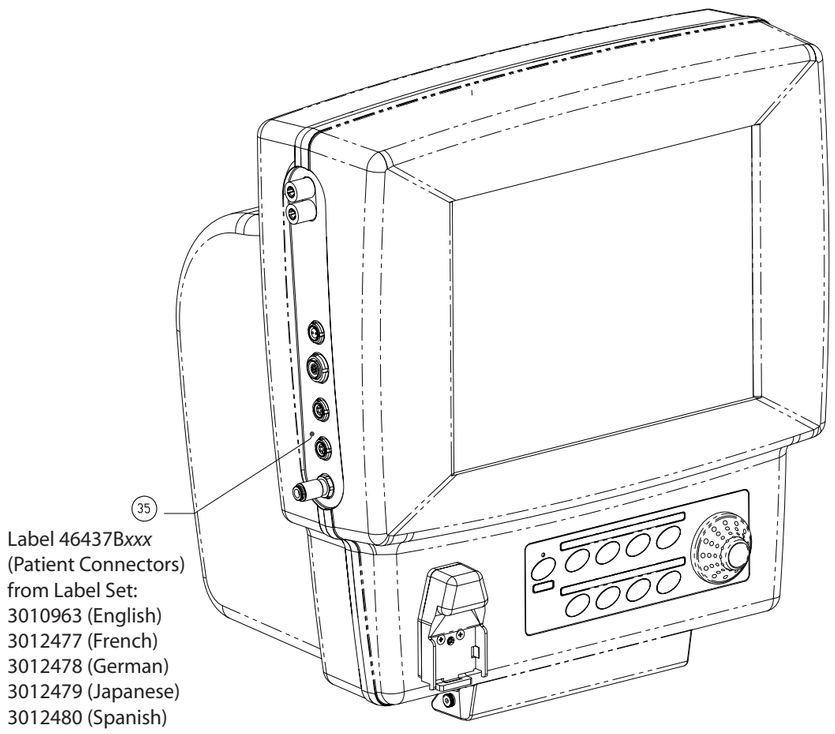

35 Label 46437B*xxx*
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3012482 (Italian)
3012483 (Swedish)
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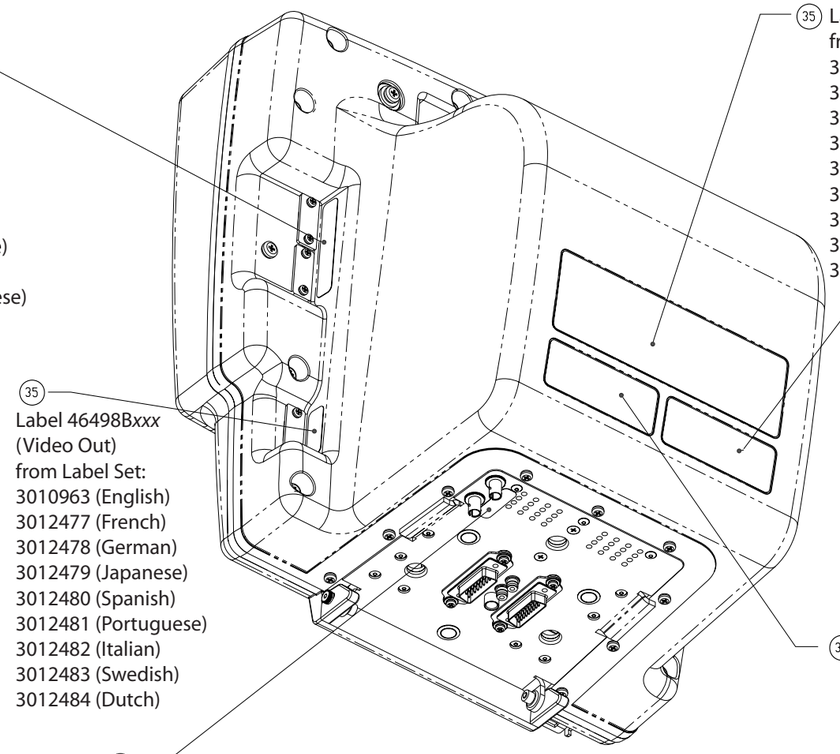
SCALE 1 : 2



35 Label 46497B*xxx*
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3012479 (Japanese)
3012480 (Spanish)
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3012483 (Swedish)
3012484 (Dutch)

35 Label 46498B*xxx*
(Video Out)
from Label Set:
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3012477 (French)
3012478 (German)
3012479 (Japanese)
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35 Label 46499B*xxx*
(Video Out)
from Label Set:
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3012478 (German)
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3012483 (Swedish)
3012484 (Dutch)

SCALE 1 : 2

35 Label 46434B*xxx* (Warnings)
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35 Label 46443B*xxx*
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from Label Set:
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3012480 (Spanish)
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3012484 (Dutch)

35 Label 46445B*xxx*
(FCC Label)
from Label Set:
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3012477 (French)
3012478 (German)
3012479 (Japanese)
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3012483 (Swedish)
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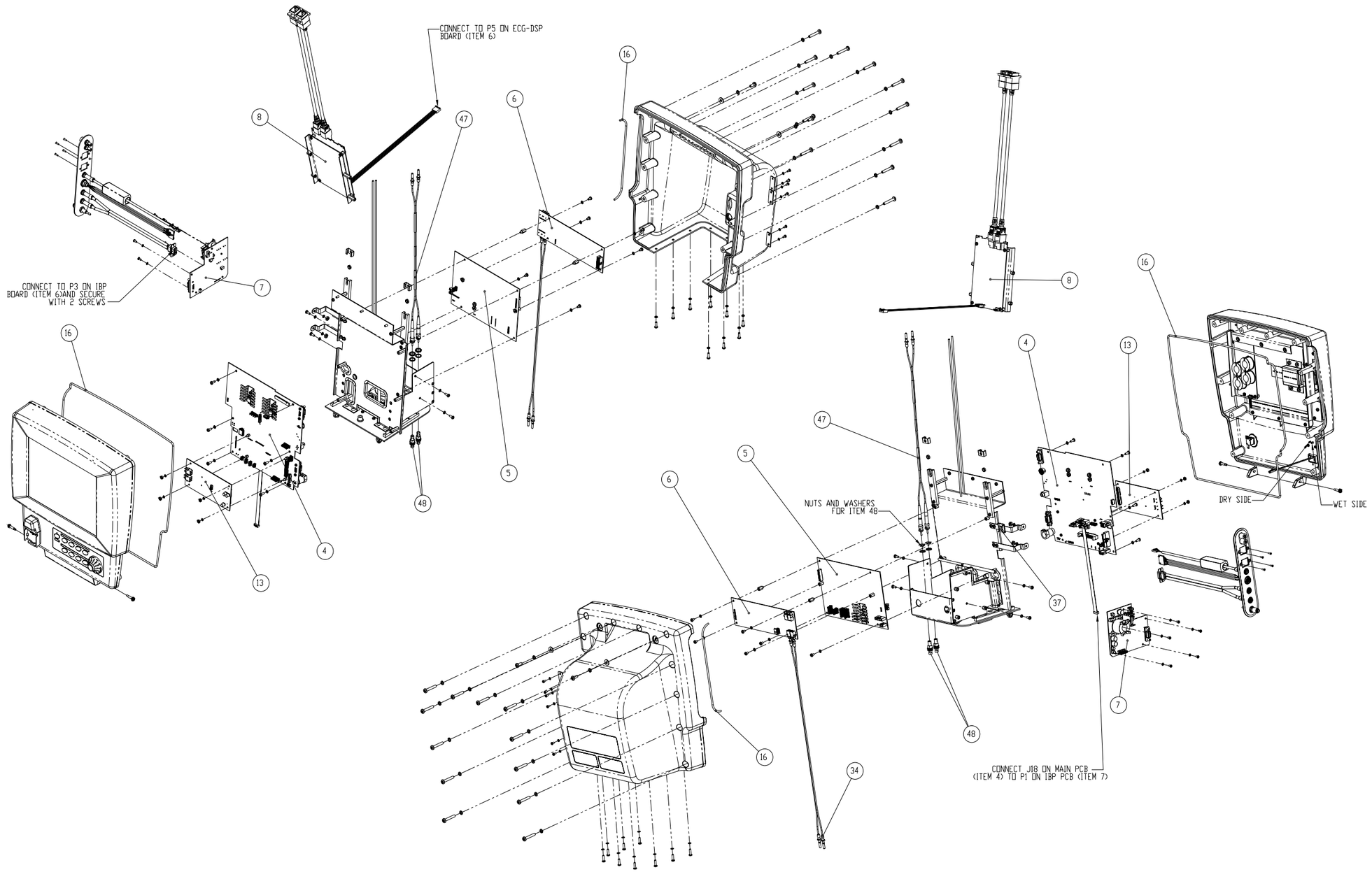
Anesthesia with Temperature
(3010946)


CONNECT TO P5 ON ECG-DSP BOARD (ITEM 6)
CONNECT TO P3 ON IBP BOARD (ITEM 6)AND SECURE WITH 2 SCREWS
NUTS AND WASHERS FOR ITEM 48
DRY SIDE
WET SIDE
CONNECT J18 ON MAIN PCB (ITEM 4) TO P1 ON IBP PCB (ITEM 7)

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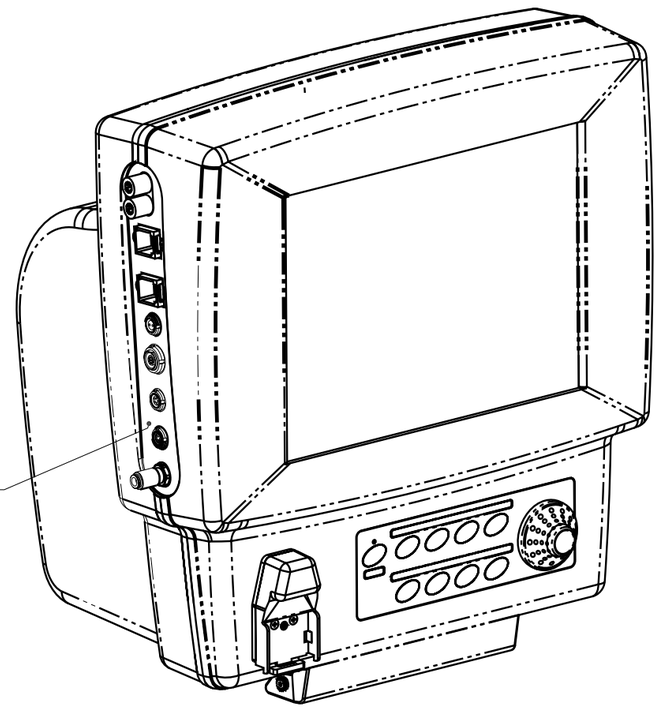

35 Label 46438B*xxx*
(Patient Connectors)
from Label Set:
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3012477 (French)
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3012484 (Dutch)

SCALE 1 : 2

35 Label 46497B*xxx*
(COMM Ports)
from Label Set:
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3012480 (Spanish)
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3012482 (Italian)
3012483 (Swedish)
3012484 (Dutch)

35 Label 46498B*xxx*
(Video Out)
from Label Set:
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35 Label 46499B*xxx*
(Video Out)
from Label Set:
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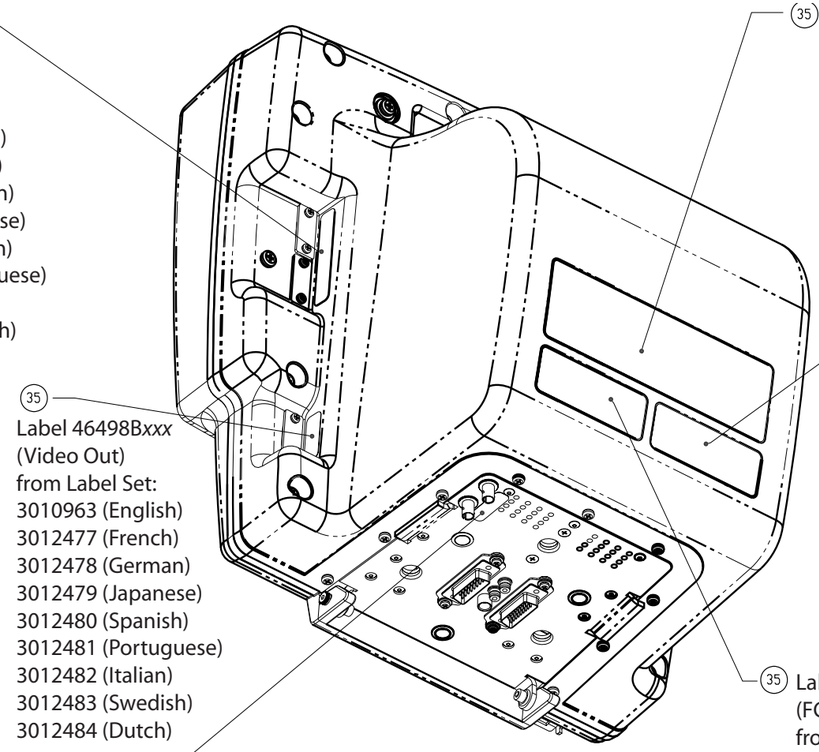

SCALE 1 : 2

35 Label 46434B*xxx* (Warnings)
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3012482 (Italian)
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35 Label 46443B*xxx*
(Serial Number)
from Label Set:
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3012477 (French)
3012478 (German)
3012479 (Japanese)
3012480 (Spanish)
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3012482 (Italian)
3012483 (Swedish)
3012484 (Dutch)

35 Label 46445B*xxx*
(FCC Label)
from Label Set:
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3012477 (French)
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3012484 (Dutch)

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7 Remote Display Maintenance and Checkout

This section contains recommended procedures for maintenance, and an operational checkout of the MEDRAD ***Veris*** remote display. Routine maintenance and inspection will:

- Ensure continued performance of the remote display.
- Reduce the possibility of equipment malfunction.

Incoming Inspection

You must inspect remote displays coming back from service for shipping damage before you place them into operation just like newly purchased remote displays. The remote display should be free from dents, cracks, or other physical damage. The quality inspection seal of the remote display should be unbroken, indicating that the remote display has been tested according to manufacturer's specifications.

If further incoming inspection or testing is required, the manufacturer recommends that you use the Alarms Verification (located in this section) as an incoming inspection test. You can perform additional electrical safety testing in this section as part of an incoming inspection in accordance with the policies of the health care provider.

Maintenance Schedule

Every 3 Months	• Clean the exterior of the unit (or clean as needed).
Every Year	• Perform the annual safety tests provided in this section**.**

Monitor Safety Testing

You can perform the following tests as part of a periodic safety check. The following safety tests are designed so that the monitor's warranty seal does not have to be broken. If the monitor fails any portion of these tests, contact MEDRAD.

The contents of this section include the following verifications and safety tests:

- Electrical Leakage
- Interface Inspection
- Manual Controls Check
- Alarm Verification
- Internal Printer
- Communications

MEDRAD recommends that you run a serviced remote display for 24 hours before you perform the tests listed above and place the remote display back into service.

Repaired modules could require more extensive testing than what is shown in this list.

Always follow ESD precautions when performing a procedure discussed in this section.

⚠WARNING⚠

- Because test procedures require working with exposed electrical circuits, only experienced electrical or biomedical technicians should perform the procedures.
- After a remote display is altered through repair or hardware adjustment, you must fully test it before use.

Equipment and Tools

The following procedures assume that the technician has an ESD safe workbench, a set of electronic hand tools, and a digital multimeter with a 10 amp setting. At the beginning of each test, special equipment can be listed. A variety of customized cables, clips, and test fixtures are also needed to complete the tests. For more information, contact MEDRAD.

Accessory Testing

Check the electrical safety of the power cord as part of the remote display safety testing.

Cleaning and Disinfecting

⚠WARNING⚠

- Shock Hazard! Before cleaning the remote display, turn the power off and disconnect the AC power cable.

- Shock Hazard! Never immerse the remote display because the remote display has an internal power source that is active even when the unit is unplugged.

Do not use abrasive cleaners on the remote display or on any sensors or probes. Abrasive cleaners damage the remote display.

With the exception of the display screen, wipe clean the exterior surface of the remote display with alcohol. Dry it with a soft, dry cloth. Because paper towels or tissues can scratch the surface of the display, use a cotton cloth to clean the remote display.

Do not use full-strength alcohol on the display screen. Repeated use of strong cleaners damages the screen. Clean the display window by wiping it clean with a soft, lint-free cloth sprayed with common glass cleaner, hwoever, do not spray glass cleaner directly on the display.

Accidental Wetting

⚠WARNING⚠

- Shock Hazard! Because a remote display is an AC-powered device, an immersed remote display presents a danger to anyone who attempts to handle the device.

Immediately perform the following steps following an accidental wetting of equipment:

1. Turn the power off. Disconnect the AC power cord from the remote display.
2. Use a clean, dry towel or cloth to remove the liquid from the remote display housing.
3. A service technician should inspect the remote display as soon as possible.
4. If the internal mechanism is saturated, allow the liquid to drain out for 24 hours before shipping.
5. If liquid has entered the remote display, it must be dried and cleaned internally. Full testing is required before you can use the monitor. Contact MEDRAD as soon as possible.

Time is critical. The longer any liquid remains in the remote display, the more damage it can do. It is important to service the remote display immediately after any liquid is spilled into it.

Fuse Removal and Replacement

There are two AC power fuses located at the rear of the remote display directly above the AC power entry socket. The remote display uses T 1A L 250V fuses (pn 3012943).

1. Press in the side clips (at the same time) with a tool and lift out the small, black access cover. The two fuse sockets are visible.

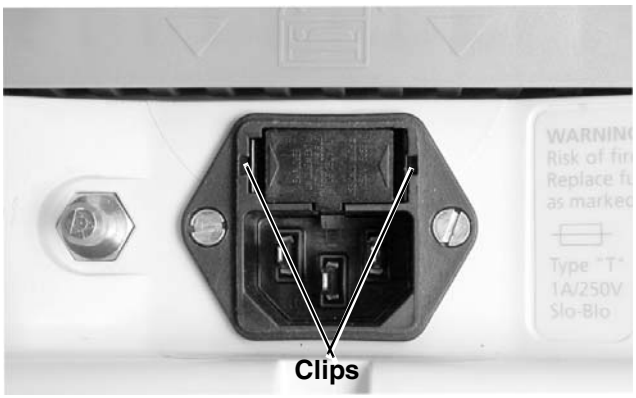


Figure 7-1: Remove the Fuse Cover

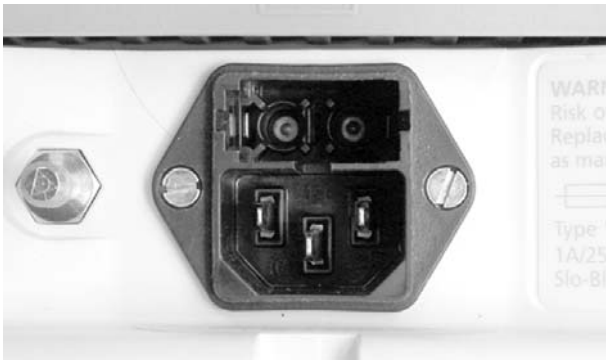


Figure 7-2: Fuses Exposed

2. Gently pull the fuses out of the fuse cover assembly.
3. Insert the new fuse(s) into the fuse cavity.
4. Place the cover back over the fuses.

For more information about troubleshooting power problems, refer to “Remote Display Troubleshooting” in Section 8 in this manual.

Long-Term Monitor Storage

No special preparation is necessary for long term storage of the remote display.

Monitor and Accessories Disposal

At the end of its useful life, you can dispose of the monitor and its accessories according to your institution's policies and procedures for disposal of patient-contact medical waste.

Alternately, you can return the monitor and its accessories to MEDRAD, Inc., for safe disposal. The shipping address is:

MEDRAD, Inc.
One Medrad Drive
Indianola, PA 15051-0780 USA

Electrical Safety Testing

Perform this test each time you open the remote display housing and before you use the remote display on patients.

⚠WARNING⚠

- Shock Hazard! Because dangerous and lethal voltages are present during the withstanding voltage, leakage, and ground continuity test, all leakage and voltage testing must be done with the monitor housing in place. For complete information about the proper operating and safety procedures, refer to the ***Veris*** *8600 Patient Monitor Operator's Manual.*

Leakage Test Equipment and Setup

Perform all testing with the cover on. The following test requires a Dynatech 232D leakage tester or equivalent.

1. Perform a self-test, if applicable, on the DYNATECH 232D by plugging it into 110 VAC outlet. Turn on the leakage tester. Set the mode switch to self test. Display should read 1000 ±20 and the *CURRENT SOURCE ACTIVE* lamp should be on.

⚠CAUTION⚠

- If these conditions are not met, do not continue with this test.

2. Set the mode switch on the Dynatech 232 to L1-L2 (line voltage). The display should read the line voltage ±10%. Set the mode switch to L1-GND. The display should read no more than 5% of L1-L2 on a grounded power system. Set the mode switch to L2-GND.

   NOTE: This should read about the same as the L1-L2 reading for a grounded system.

Leakage Test Procedure

The remote display must be powered up during all of the isolation tests.

1. Verify Earth Leakage with Open Ground is <0.25mA @ 120VAC line Voltage.
2. Verify Earth Leakage with Reverse Polarity and Open Ground is <0.25mA @ 120VAC line Voltage.
3. Verify Earth Leakage with Open Neutral and Open Ground is <0.25mA @ 120VAC line Voltage.
4. Verify Earth Leakage with Reversed Polarity, Open Neutral and Open Ground is <0.25mA @ 120 line Voltage.

Functional Testing

Encoder Verification

Verify that the encoder functions properly.

Fiber Optic Communication

To verify fiber optic communication:

1. Enter the *CONFIG* screen, then select *Enter Network Config*. *Enter Network Config* is password protected.
2. Set the following parameters:

- Sync Type Fiber Optic
- IP Adress 192.168.000.XXX
- Net Mask 255.255.255.000
- Port 02571
- Channel Type Peer-to-Peer
- Channel X
- SSID Any

3. Select *Exit* to save the settings.
4. Connect the remote display to a main monitor test set-up with fiber optic cables.
5. Select *Connect Fiber Optic*.
6. Use the encoder to verify that the screen on the remote display replicates what is present on the main monitor.

Display Performance

1. Verify that the display is showing a readable screen. The patient parameters should display along the right hand of the screen and waveform names along the left side (no ECG waveforms are present).
2. There should be no intermittence or jittering of pixels. The maximum amount of pixels missing from any display are as follows:
   - Seven dots are the maximum allowed per screen
   - Only 1 dot within a 20mm radius circle

Interface Performance

1. Install Paper into the printer and Press the PRINT key. Verify that the printout is clear. If the printer does not function, verify that the printer is set to *Internal Printer* in the *CONFIG* menu.
2. Press the NIBP key on the remote. Verify that the NIBP pump is running on the Main Test unit.
3. Press the NIBP CYCLE/STAT key. Verify that the *Cycle/Stat* menu appears on the remote screen.
4. Press the FREEZE key. Verify an audible response from the speaker. Press the FREEZE key a second time to unlock waveforms.
5. Press the TREND key. Verify an audible response from the speaker. Verify that a trend screen appears on the display. Press the TREND key again to close the trend screen.
6. Press the DEFAULT key. Verify an audible response from the speaker. A *Restore Unit Defaults* window appears. Choose *CANCEL* in the response and press the encoder twice to exit back to the main screen.
7. Press the STAND BY key. Verify an audible response from the speaker. A standby confirmation menu should appear. Press the encoder button to close menu.
8. Attach an ECG simulator to the Main Test Unit and set the heart rate to 300BPM. Verify that the remote is alarming. This is also a speaker verification for the remote.
9. Press the SILENCE key to silence the alarm. Verify the message *2 Min* next to a bell with an X through it appear in the upper right hand corner of the main window.

10. Press and hold the SILENCE key for 2 seconds to turn off the alarm. Verify that the infinity symbol and a bell with an X through it appear in the upper right hand corner of the main window.

Remote Printer Function

1. Press the PRINT key on the Main Test unit. Verify a remote print out matching step 1 in “Interface Performance” on page 7-8 is printed from the remote unit under test.

External Display Function

To verify the External Display function:

1. Enter the *DISPLAY* menu and update *External Display* to *ON*.
2. Connect a Standard video cable to the video port and verify the screen of a standard VGA monitor matches the display.

Visual Inspection

Visually inspect the unit for all cosmetic faults and assure that all hardware is in place and tight.

Field Service Testing Safety

⚠WARNING⚠

- Service testing procedures require working with exposed electrical circuits and should only be attempted by experienced electrical or biomedical technicians.
- When a remote display is altered through repair or hardware adjustment, it should be fully tested before use.

⚠CAUTION⚠

- Always follow ESD precautions when performing any procedure discussed in this section.
- Modules and PCBs that have been repaired may require more extensive testing than what is described in this manual.

The pre-assembly testing of printed circuit boards (PCBs) is not covered in this manual. Disassembly of surface mounted components on PCBs is not recommended. Tests provided here are only for the identification of damaged or degraded PCBs.

Remote Display Fault Testing

The following procedures are used to determine whether boards and assemblies are damaged. New boards and mechanical assemblies should be tested as part of any replacement repair.

Board level tests require opening the remote display housing which can void your product warranty.

Always follow ESD precautions when performing these procedures.

⚠DANGER⚠

- High Voltage! Board testing requires working with dangerous voltages. The rear assembly, that contains the power supply module, should only be serviced by experience electrical technicians.

Power Supply PCB Test

1. Remove the remote display from AC power.
2. Open the case.
3. Follow the disassembly procedures (refer to “Remote Display Disassembly” in Section 10 in this manual) to expose the power module PCB. Do not remove the power module PCB.
4. Disconnect the DC power cable at PS2 of the Main Board. Leave the other end attached to the Power Supply Board.
5. Using a controlled AC source, apply 115 VAC at 60 Hz to the AC receptacle. The source should be able to supply a minimum of 3 amps. (Use a power cable that has suitable connections to the AC source.)
6. Measure the DC power cable end. The power module should supply 15.6 VDC (±0.1V).
7. Proceed to the next step if the voltage is within specification. If it is a new board under test, it might not be calibrated. The trim potentiometer on calibrated boards should be varnished or otherwise sealed.
8. Remove the power module. Verify that the trim potentiometer measures 15.6 VDC.
9. Reassemble the remote display.

Main Board Testing

1. Verify that the shunts at JP5 and JP6 are set to +PRWSW and REMOTE, respectively
2. Connect a speaker to J21 on the Main Board.
3. Connect a membrane switch to J6 on the Main Board.
4. Attach a rotary menu knob to J3 on the Main Board.
5. Connect a 16VDC 3A power supply to connector PS2 on the Main Board.
6. Insert an ammeter inline with the positive lead from the power supply.
7. Press the ON/OFF key and verify that the “on” current to the board is less than 300mA.
8. While using TP27 as ground, verify the following voltages:
   - +16.00 (±0.5) VDC @ TP25 (+PWRUNSW)
   - +5.00 (±0.1) VDC @ TP21 (+5D)
   - +5.00 (±0.1) VDC @ TP28 (+5P)
   - +3.3 (±0.05) VDC @ TP23 (+3.3D)
   - +8.00 (±0.25) VDC @ TP29 (+8V)
   - -5.00 (±0.1) VDC @ TP20 (-5A)
   - +5.00 (±0.025) VDC @ TP18 (+5VREF)
   - +3.30 (±0.1) VDC @ TP22 (+3.3B)

Communication Board Testing

1. Complete a visual inspection of the PCB followed by an “in circuit” test.
2. Setup up the remote display for fiber optic communication.
   a. Attach one of the fiber optic duplex cables to the Communication PCBA.
      - The black lead of the duplex cable connects to U7 on the Communication PCBA.
      - The blue lead of the duplex cable connects to U5 on the Communication PCBA.
   b. Attach the unconnected ends of the duplex cable to two of the bushings.
   c. Attach the terminated fiber optic cable.
   d. The fiber optic cable marked “Rx” connects to the duplex cable labeled BLACK.
   e. The fiber optic cable marked “Tx” connects to the remaining duplex cable.
   f. Connect the remote display to the remaining Main PCBA.

      NOTE: The remote display will be connected to the unconnected ends of the terminated fiber optic cable.
3. Connect each Main PCBA to one display assembly, one rotary encoder, and one membrane switch.
4. Turn off both units.
5. Sync the two (2) units through fiber optic communication.
   a. Set the network settings on the main PCBA with main code.
      - Turn on the unit.
      - Go to the *CONFIG* menu and select *Enter Network Config*.
      - Enter the password `MEDRAD` and select *YES*.
      - Select *Sync Type* and select *Fiber Optic*.
      - Select *EXIT*.
   b. Set the network settings on the main PCBA with remote code.
      - Turn on the unit.
      - Select *Configure*.
      - Select *Sync Type* and then select *Fiber Optic*.
   c. Restart the unit with main code and select “Exit” on the unit with remote code.
   d. Select *Connect Fiber Optic* on the unit with remote code.
   e. Verify that the two units sync through fiber optic communication.

8 *Remote Display Troubleshooting*

This section lists the possible causes of remote display problems. Use this table and the schematics in “Remote Display BOMs and Drawings” in Section 11 to identify and locate components that malfunction.

Symptom	Problem	Solution
Unit won’t power up (On/Off LED is dark)	• AC power cord is not securely connected to the remote display	Connect AC power cord to the remote display
	• AC outlet off or unpowered	Connect power cord to a live outlet
	• Fuses are blown (Located above AC connection	Replace AC fuses
	• Main PCB is disconnected	Reconnect power cable at PS2 on Main PCB
	• Bad membrane	Replace the keypad membrane
	• Main PCB fuse blown	Replace F3 on Main PCB
	• Main PCB failed	Replace Main PCB
Cannot activate hardkey function or turn on monitor with AC power (On/Off LED is green)	• Membrane panel is disconnected or loose	Reconnect ribbon cable to J6 on Main PCB
	• Keypad membrane is bad	Replace keypad membrane panel
Cannot activate softkeys with rotary knob	• Rotary knob is disconnected or loose	Reconnect cable to J3 on Main PCB
	• Bad rotary knob	Replace rotary knob
Display is blank or not readable	• Video screen cables to Main PCB are disconnected or loose	Reconnect data and inverter cables to connectors on the Main PCB (J2 and/or J7)
	• Inverter not plugged in	Make sure all Inverter connections are secure.
	• Bad inverter	Replace the inverter
	• Bad display	Replace display
No sound from speaker	• Volume turned down	Set volume higher in Configuration (*CONFIG*) window.
	• Main PCB connection is disconnected or loose	Reconnect J21 on Main PCB
	• Speaker wire broken at speaker terminals	Check speaker wires for breaks or bad crimp pins
Speaker scratchy or unclear	• Metal debris on speaker	Remove debris from speaker drum
	• Bad speaker	Replace speaker

Symptom	Problem	Solution
Remote cannot communicate with the main monitor (hard wire)	• Fiber optic cable to remote display may be loose or disconnected.	Reseat or reconnect fiber optic cable.
	• Fiber optic cables not connected properly	Make sure that the fiber optic cables go from “TX” to “RX”. They should NOT go “TX” to “TX”/”RX” to “RX”
	• Fiber optic cable may be bad.	Replace fiber optic cable.
	• Remote display may be malfunctioning	Try another remote display with the system.
	• Network settings in the *CONFIG*. menu may be incorrect.	Reset network settings to correct settings.
	• Communication Board may not be seated tightly to the Main Board.	Verify Communication Board is seated to the Main Board.
	• Communication Board may be bad.	Replace Communication Board
COM 1 serial interface doesn’t work	• Set to internal printer	Reset monitor to external printer
	• Incorrect or bad cable	Replace with correct serial cable
	• Setting mismatch	Reset baud rate and other settings
	• Connector is bad	Replace the Main PCB
Printer doesn’t print	• Not set to internal printer	Set the *Print Device* to *Internal Printer* in the *CONFIG* menu
	• Printer connection is disconnected or loose	Reconnect J9 on the Main PCB and/ or CN2 and CN3 on the Printer PCB
	• Bad printer	Replace printer
	• Bad Printer PCB	Replace Printer PCB

Troubleshooting and Repair

Before attempting to repair a damaged remote display the technician must fully understand the functions of the remote display. The service technician should have read and understood all the previous sections of this manual.

You must fully repair, calibrate, and test all damaged remote displays before you use them on patients. The remote display must meet the original operating specifications before you use it on a patient.

Always follow ESD precautions when performing any of the procedures discussed in this section.

Main Board

The Main PCB contains the primary processors, storage memory, communication interfaces, audio driver, power regulation, and video generation and keypad inputs (User I/O).

The main ground cable and the display ground cable are part of the Main PCB assembly.

There is one replaceable fuse (3A PICO 125V SLO-BLO) for the power supply module at PS2 (F4 protects the supply output).

The Main PCB is not a field-repairable component. Replacement Main PCBs are pre-tested, programmed, and calibrated.

⚠DANGER⚠

- High Voltage! Repairing and testing the power supply requires working with dangerous voltages. The power supply module should only be serviced by experienced electrical repair technicians.

Communication

DPAC Communications Board

The DPAC Communications PCB facilitates communications with the main monitor through the fiber optic ports. The DPAC Communications PCB connects to J1 of the Main PCB. The fiber optic cables connect at U5 and U7 on the DPAC Communications PCB.

Fuse Replacement

The main fuses (pn 3012943) for the remote display is located in an external compartment above the AC power cord connection. Replace only with T 1A L 250V fuses.

You do not have to open the remote display case to change the main power fuses. See “Fuse Removal and Replacement” on page 7-4.

⚠WARNING⚠

- Shock hazard. Substitution of fuses or jumping the fuse contacts can endanger the patient and damage the remote display.

AC Power Components

The power entry assembly is composed of two AC chokes, a ferrite, and power cable connections. The source connections attach directly to the AC receptacle fuse assembly.

Replace broken, cracked, or loose AC receptacles. Replace the receptacle if the external pins are bent or broken. Do not attempt to remove or modify the ground pin!

Check the cables and chokes for heat damage before power module replacement. Remove the assembly from the housing and inspect the back side of the board for scorching or damaged solder connections. Replace the entire assembly if there are any signs of high current damage.

9 *Remote Display Theory of Operation*

Overview

The ***Veris*** color remote display is an option with the ***Veris*** MR patient monitoring system. This remote display duplicates the features and functionality of the main monitor interface. The remote display has no patient sensor interface capability.

The remote display is wall powered with no battery. The remote display is not MR compatible.

The remote display employs a universal switching power supply for international use.

In order to monitor the status of the line power, and condition of the battery pack, the internal power supply circuitry drives several status lines available to the main module. The power management/ watchdog circuit provides a low battery level detection mechanism and a hardware-based check on software operation (watchdog timer).

Communication

The remote display communicates to the patient monitor via a direct fiber optic cable interface. The remote display has a hardwire output port providing CUSP communication to the main monitor. The communication interface is operational up to 200 feet from the patient monitor in the scan room to the remote display in the control room.

The remote display has 1 analog output representing user selectable waveforms. The remote display has a serial output representing the corresponding numeric data associated with each parameter.

Printer Interface

The remote display has a standard printer interface for an internal thermal line printer.

Main CPU and System

The microprocessor circuitry handles the Main Board computational functions and provides integrated I/O functions, including timers, I/O pins, serial interfaces, and analog I/O.

Speaker Driver

The speaker drive circuit is a DAC controlling speaker volume and an output pin to control frequency. A software-controlled timer generates a square-wave signal that drives the speaker. Hence, any drive frequency has harmonic components, and generates no “pure tones.” Applicable standards recommend against the use of pure tones in alarm situations to reduce the risk of an individual with a “notch” hearing deficit missing an alarm.

Communications

The monitor provides two patient-isolated external RS-232 serial data ports (TX, RX, and ground):

- The DB-9 COM1 port is configured for compatibility with ASCII printer applications.
- The DIN-8 COM2 port is custom-configured with one pin reserved for analog output.

The main module drives a patient-isolated external analog output. It provides a 0 to 1 v output capable of driving a high-level input, such as a defibrillator or chart recorder.

Printer

The Main Board powers and controls the printer module. The Main Board processes error messages from the Printer Board and displays them on the screen. The internal printer module is a Sieko LTP1245-type mechanism.

Block Diagram

The following block diagram aids in tracing communication and data routes within the remote display system. Connection numbers are given to show the relationship between the boards. The diagram is keyed to the theory of operations found on the previous pages.

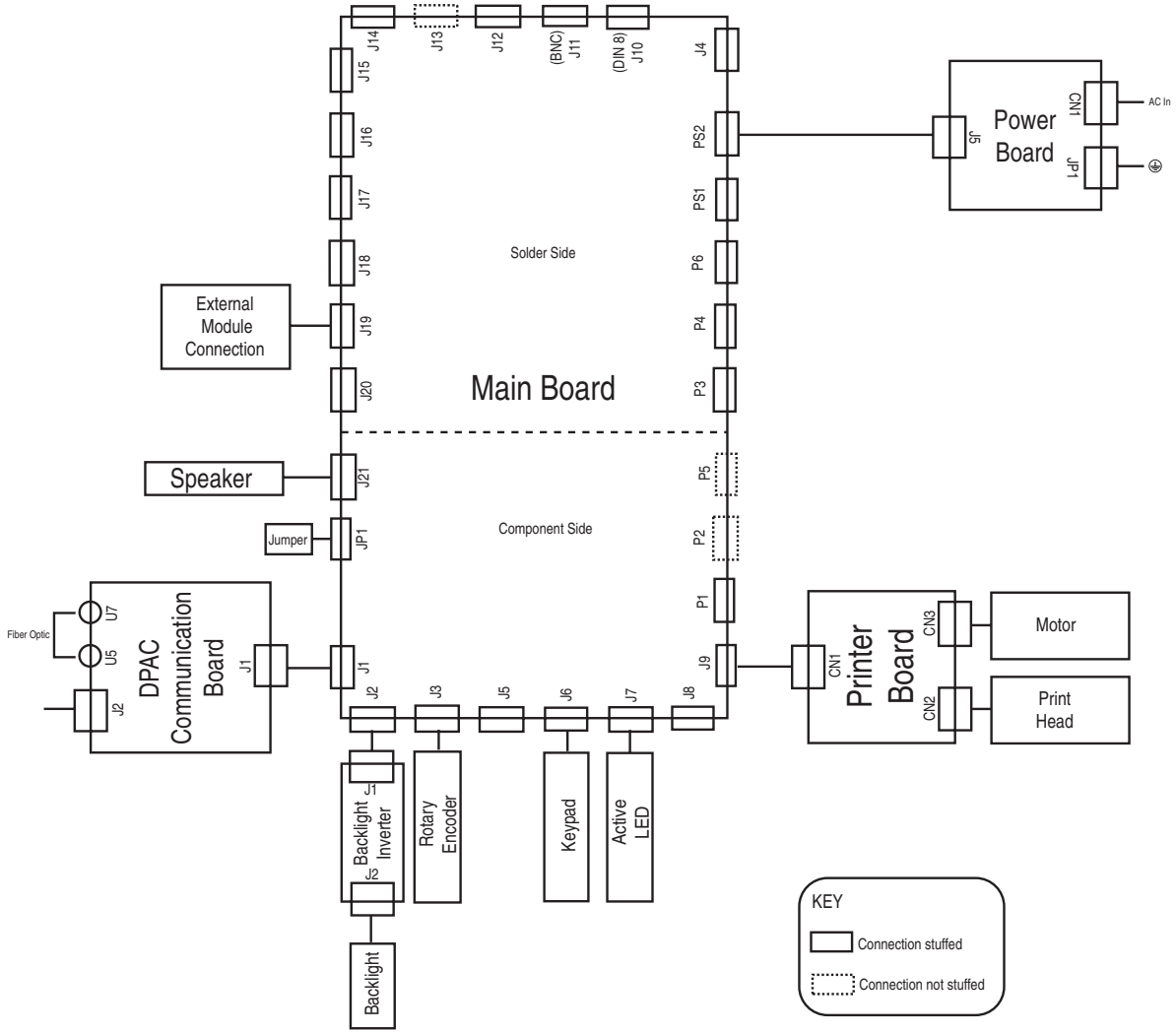


Figure 9-1: PCB Interconnect Diagram

10 *Remote Display Disassembly*

Before You Begin

Tools Needed

- Proper ESD mat and antistatic grounding straps
- #1 Philips screwdriver
- #2 Philips screwdriver
- Small flat scredriver
- 10mm socket, deep well
- 1/4 inch socket, deep well
- 7/16 inch socket, deep well
- 3/8 inch socket, deep well
- Grounded soldering iron

Supplies Needed

- Kapton tape
- Labeling material
- Cotton cloth
- Rubbing alcohol

Precautions

1. Turn the monitor off.
2. Disconnect the AC (Mains) power cord.

⚠WARNING⚠

- The procedures presented in this section are intended to be implemented by qualified biomedical engineering or field service personnel for PCB assembly replacement.
- The procedures presented in this section are not intended to be used for component-level trouble shooting and repair of the PCB assemblies. Only MEDRAD service personnel are authorized to perform component-level repair.
- Possible safety hazard. Read the battery safety information provided in “Important Safety Notice” on page 1-3

The repair procedures for the remote display are included here for the determination of damaged or unusable assemblies. MEDRAD does not recommend attempting the field repair of the printed circuit boards (PCBs).

Service Safety

⚠DANGER⚠

- The remote display contains an internal AC power supply that contains potentially lethal voltages.
- High Voltage! The internal Power Supply PCB has a protective shield that should not be removed during service. If the power supply is defective, replace the entire Power Supply assembly.

Electrostatic Discharge Protection

The procedures in this section require handling of electrostatic sensitive components. Microprocessors and other electronic components can be permanently damaged by attempting repairs at an unprotected workbench.

Use all electrostatic discharge (ESD) protection as described!

- Perform the disassembly procedure on an antistatic mat that is grounded. Check the ground cable to insure that it is connected to a good earth ground.
- Use a grounded soldering iron.
- Wear a wrist-grounding strap.
- Connect the wrist strap and mat through a resistor (1 megohm typical) to the same ground source.
- Test the wrist-ground straps on a daily basis.
- Temporarily store components in metal or antistatic containers. Do not store components in plastic dishes. Store circuit boards in sealed antistatic bags or cover them in antistatic boxes. Do not store electronic boards directly in cardboard boxes.

Front Housing Removal

Follow the ESD cautions discussed in “Electrostatic Discharge Protection” on page 10-2.

1. Remove the eight (8) Philips screws holding the front and rear assemblies together.

Figure 10-2: Philips Screws on the Back of the Monitor

2. Carefully pull off the front housing in order to avoid pulling any wires.

   NOTE: The unit may be hard to open due to the curing of the adhesive on the water ingress shield. Carefully separate the housing taking care that you don’t crack the housing.

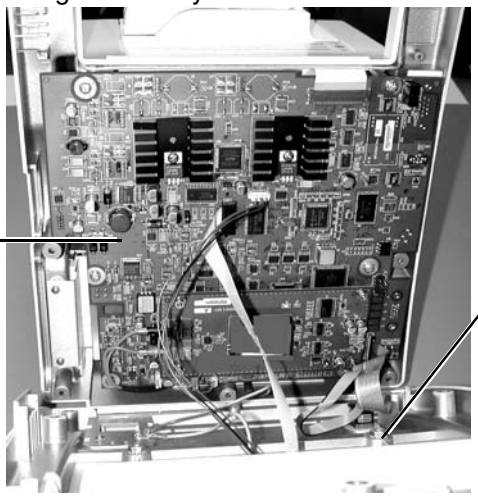


Figure 10-3: Remove the Front Housing

3. The printer cable has a ZIF connector. Unlock the connector before remove the cable. Label and disconnect the printer cable from J9 of the Main PCB.

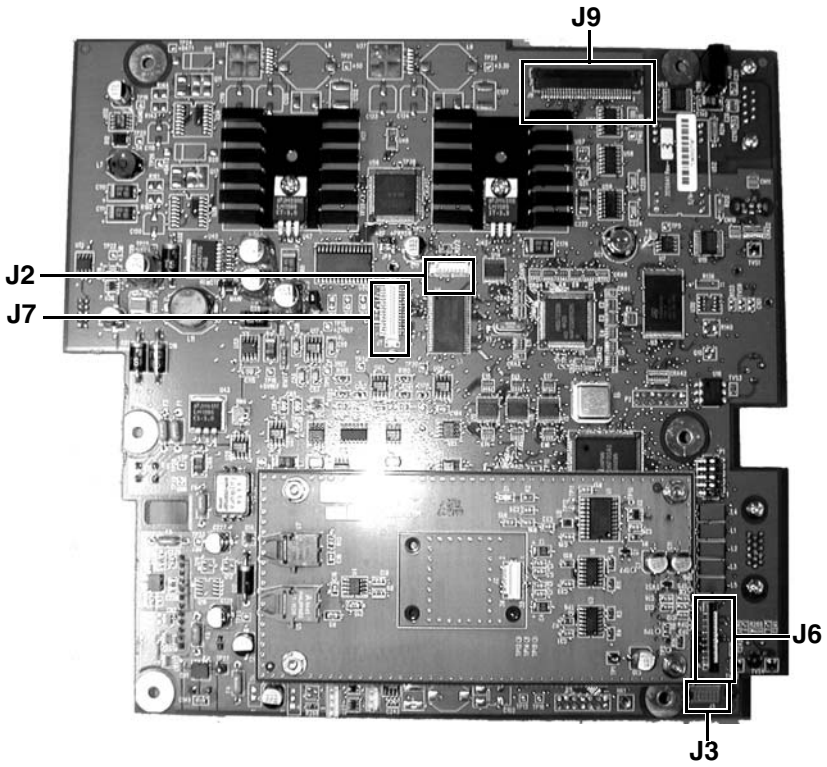


Figure 10-4: Main PCB Connector Side Connections

4. Label and disconnect the fiber optic cables from U5 and U7 on the DPAC Communication PCB.

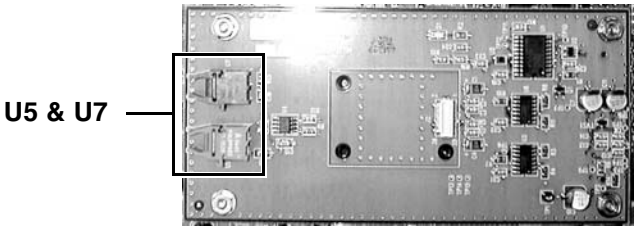


Figure 10-5: DPAC Communication PCB

5. Remove the Main/Communication assembly from the chassis. This assembly is held with six (6) #6 screws.

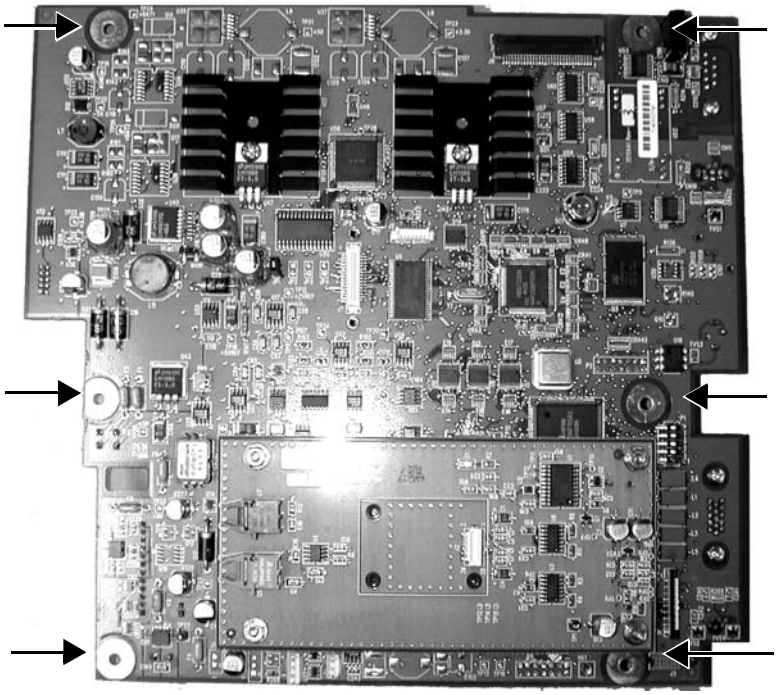


Figure 10-6: Remove the Six Screws

6. *If the DPAC Communication PCB needs to be replaced*, remove the DPAC Communication PCB from the Main PCB.

   If only the Main PCB needs to be replaced, remove the DPAC Communication PCB from the Main PCB to attach to the new Main PCB.

7. Label and disconnect the two (2) display cables from J2 and J7 of the Main PCB. See "Figure 10-4: Main PCB Connector Side Connections".

8. Note the orientation of the membrane cable in the ZIF connector. Unlock the ZIF connector. Label and remove the membrane cable from J6 of the Main PCB. See "Figure 10-4: Main PCB Connector Side Connections".

9. Label and remove the rotary encoder knob cable from J3 of the Main PCB. See "Figure 10-4: Main PCB Connector Side Connections".

10. Lay the display front housing flat on the table.

11. Remove the ground cables held in place with a Philips screw.

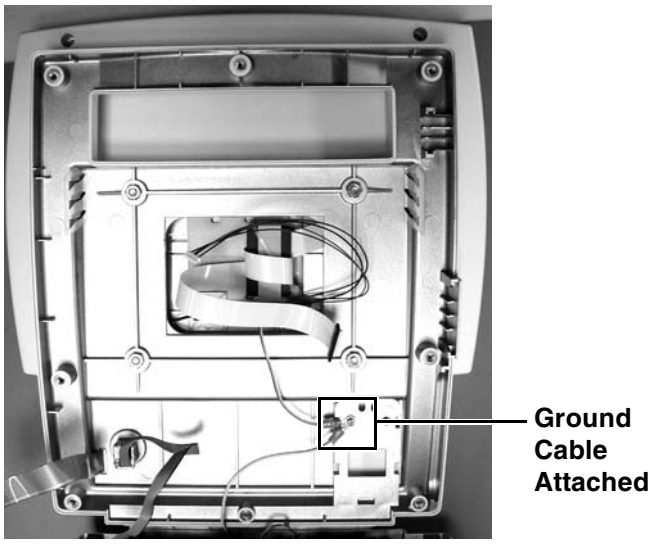


Figure 10-7: Remove the Ground Cable

12. Remove the front housing assembly.

Front Housing Disassembly

Rotary Encoder Knob Removal and Replacement

1. With a flat screwdriver pry the rotary encoder knob from the remote display.

Figure 10-8: Remove the Rotary Encoder Knob

2. Remove the retaining nut and lock washer from the front of the housing. Remove the assembly from the front housing.

3. Install the rotary encoder onto the front enclosure and secure using the supplied lock washer and nut. Ensure that the encoder is oriented so that the cable is towards the far edge (right).

4. Cover the backside of the encoder with kapton tape. Ensure that all exposed metal is covered.

5. Install the encoder knob onto the encoder. Press the knob onto the shaft of the encoder completely.

   NOTE: The encoder knob and the shaft are keyed.

Membrane Keypad Removal and Replacement

Use this procedure only if you need to replace the membrane keypad on the remote display.

NOTE: Once you remove a membrane from the front panel you cannot reattach it to the front panel.

1. With a flat screwdriver pry the rotary encoder knob from the unit.

Figure 10-9: Remove the Rotary Encoder Knob

2. Push a flat screwdriver through the ribbon cable slot to begin peeling the membrane off the front of the unit. Do not attempt to use tools to peel the membrane from the front as you may mar the case and be unable to properly attach the new membrane.

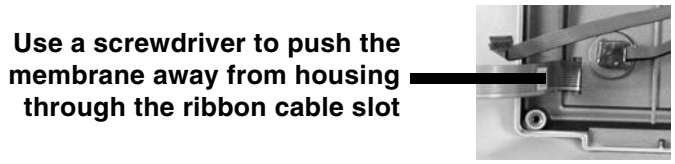


Figure 10-10: Removing Membrane

3. Peel the membrane away from the front housing.

4. Remove any excess glue from the front housing. Use a cotton cloth dampened with alcohol.

   NOTE: If any glue remains on the housing, the new membrane cannot adhere properly.

5. Remove the protective backing from the adhesive on the new membrane.

6. Install the new membrane. Line up the membrane along a straight edge and lay the membrane into place. Press down firmly on the membrane when it is in position.

   NOTE: Make sure that all of the air is removed from under the membrane switch.

7. Reattach the encoder knob onto the encoder. Press the knob onto the shaft of the encoder completely.

   NOTE: The encoder knob and the shaft are keyed.

Display Assembly Removal and Replacement

1. Remove the four (4) nuts from the interior frame of the front housing assembly. The front housing comes apart from the display.

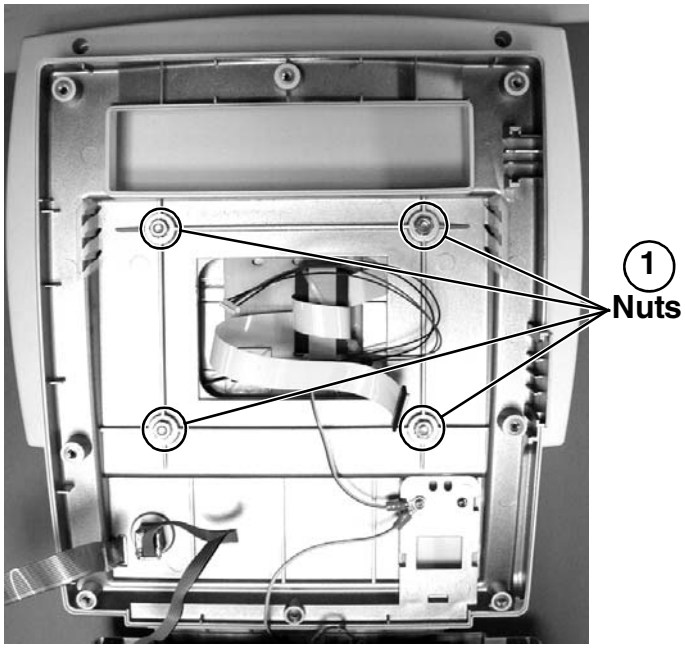


Figure 10-11: Remove the Display Nuts

2. Lift the front up. Allow the cables to slide through the access hole.

3. Remove the four (4) screws that hold the display housing together.

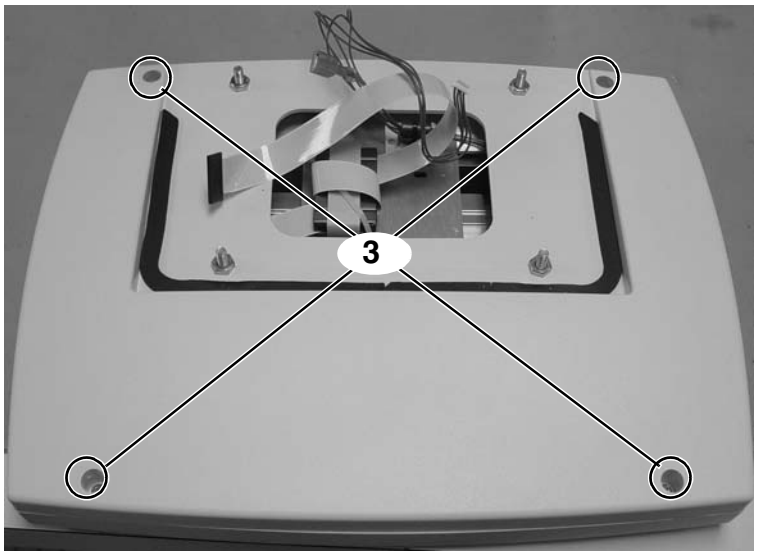


Figure 10-12: Remove the Display Housing Screws

4. Remove the back half of the display housing.

Inverter PCB Removal and Replacement

1. Label and disconnect the cables (Item 1 on the photo) on the Inverter PCB.

2. Remove the two (2) small Philips screws and plastic washers.

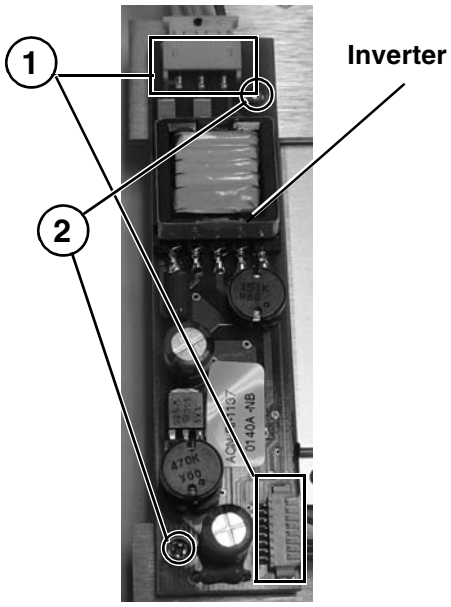


Figure 10-13: Remove the Inverter PCB

3. Remove and replace the Inverter PCB.

4. Fasten the Inverter PCB with the two (2) screws and nylon washers you removed earlier. (See #2 in "Figure 10-13: Remove the Inverter PCB".)

   NOTE: When you install the new Inverter PCB, be sure the nylon standoffs are in place.

5. Reattach the cables. (See #1 in "Figure 10-13: Remove the Inverter PCB".)

Display Screen Removal and Replacement

1. Remove the four (4) Philips screws.

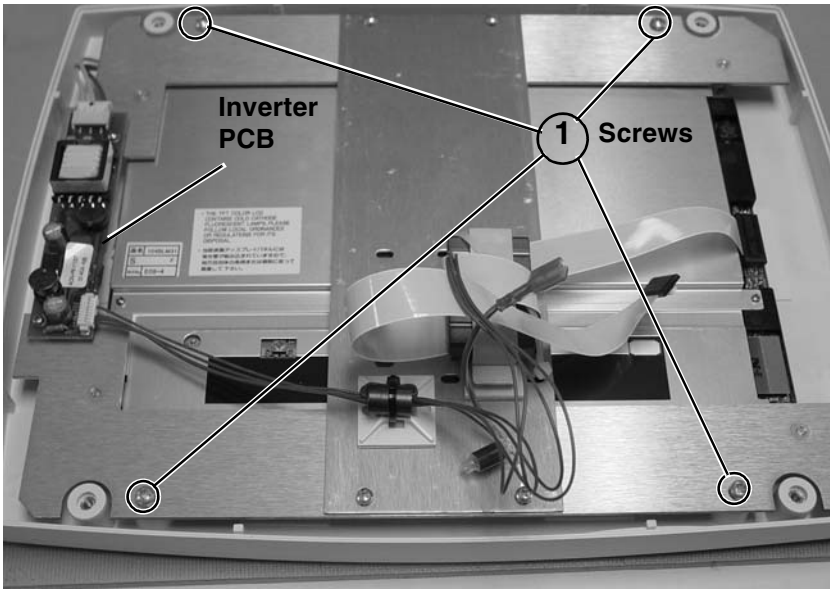


Figure 10-14: Remove the Display Housing Screws

2. Label and disconnect the cable at Label 2 from the Inverter PCB.

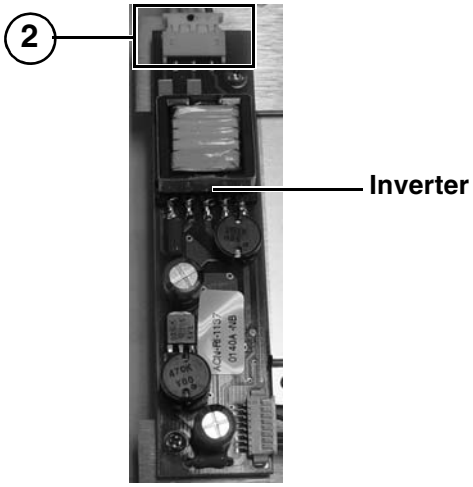


Figure 10-15: Remove the Inverter PCB Connection

3. Disconnect the ribbon cable from the display.

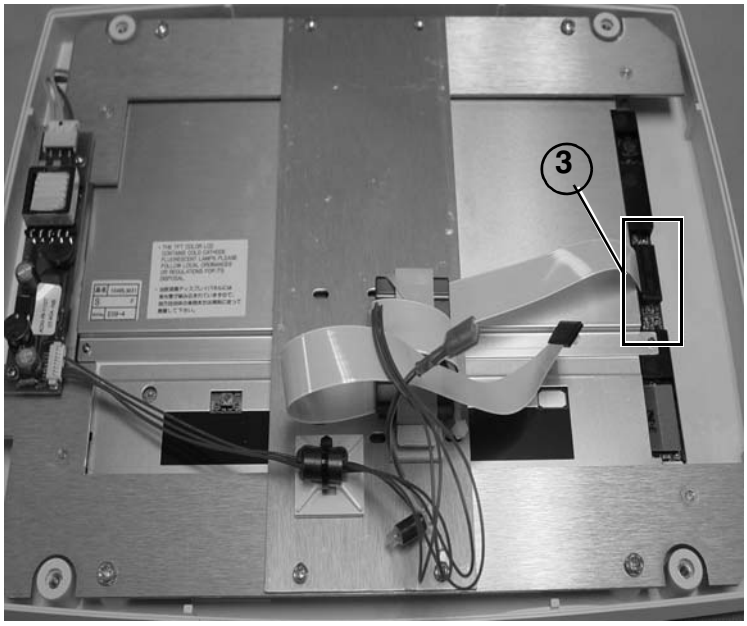


Figure 10-16: Remove the Ribbon Cable, Display Screws

4. Turn the display over and remove the four (4) Philips screws.

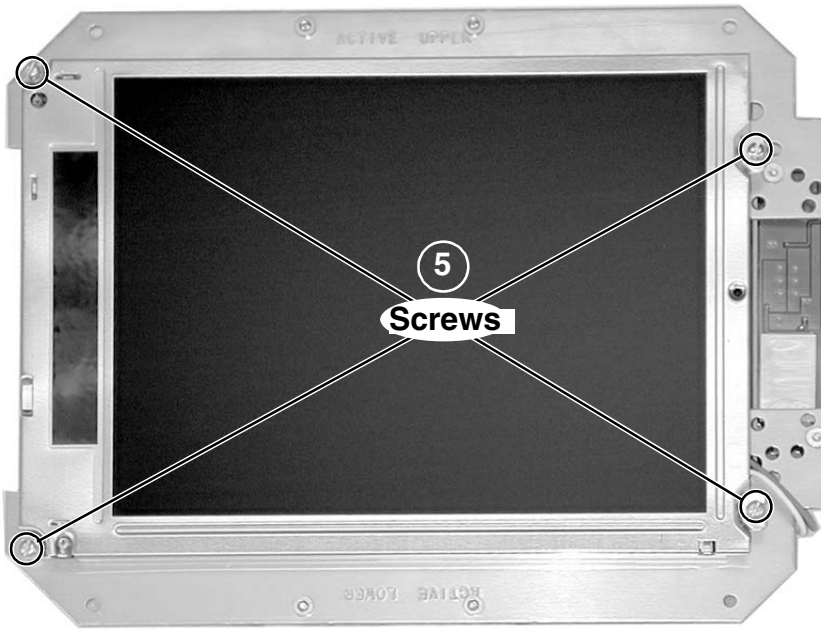


Figure 10-17: Remove the Display Screws

5. Remove and replace the display screen.

NOTE: Be sure the display and the inside of the clear cover are clean before you re-assemble the assembly.

6. Reassemble in reverse order.

Printer Removal and Replacement

1. Remove the paper roll from the unit.

2. Remove the two (2) Philips screws that hold the printer assembly.

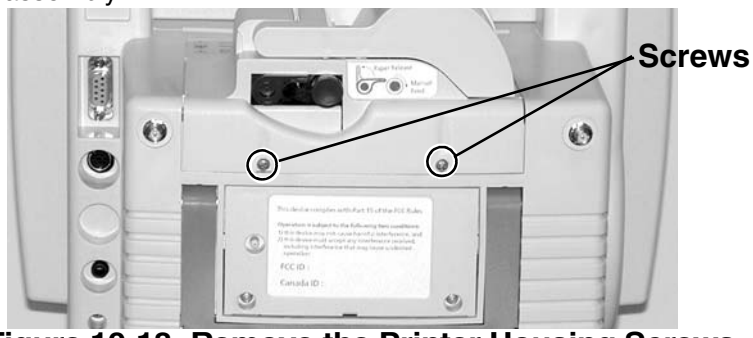


Figure 10-18: Remove the Printer Housing Screws

3. Disconnect the ribbon cable from CN1 on the the Printer PCB.

4. Remove the printer assembly.

5. *If the Printer PCB needs to be replaced*, remove the four (4) Philips screws from the Printer PCB.

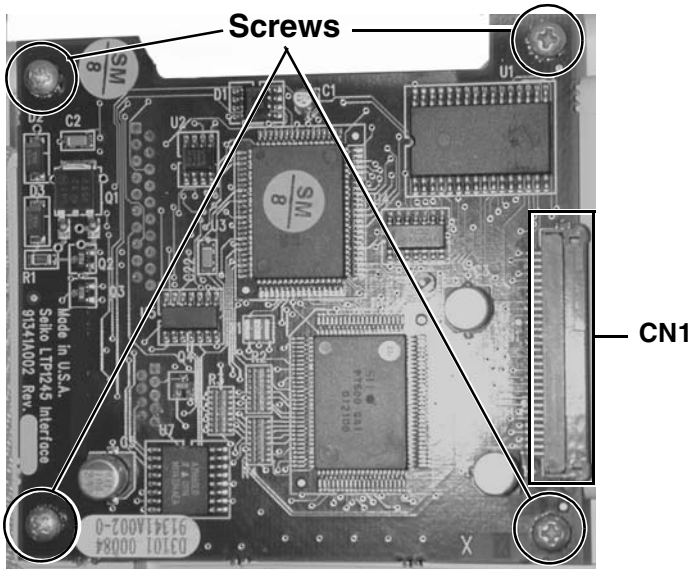


Figure 10-19: Printer PCB Screws

6. Lift the Printer PCB away from the unit.

7. Label and disconnect the cables from CN3 and CN2 on the back of the Printer PCB.

8. Remove the metal plate and shielding.

9. Remove the printer from the housing.

10. Replace the printer and/or Printer PCB and reassemble the remote display.

Rear Housing Disassembly

Follow the ESD cautions discussed in “Electrostatic Discharge Protection” on page 10-2.

Because the interior of the rear assembly contains exposed AC contacts, you must disconnect the AC power before you begin the disassembly procedure. See “Before You Begin” on page 10-1.

Main PCB Removal and Replacement

1. Remove the front housing, as described in “Front Housing Removal” on page 10-3.

2. Remove the six (6) Philips screws shown in the picture below.

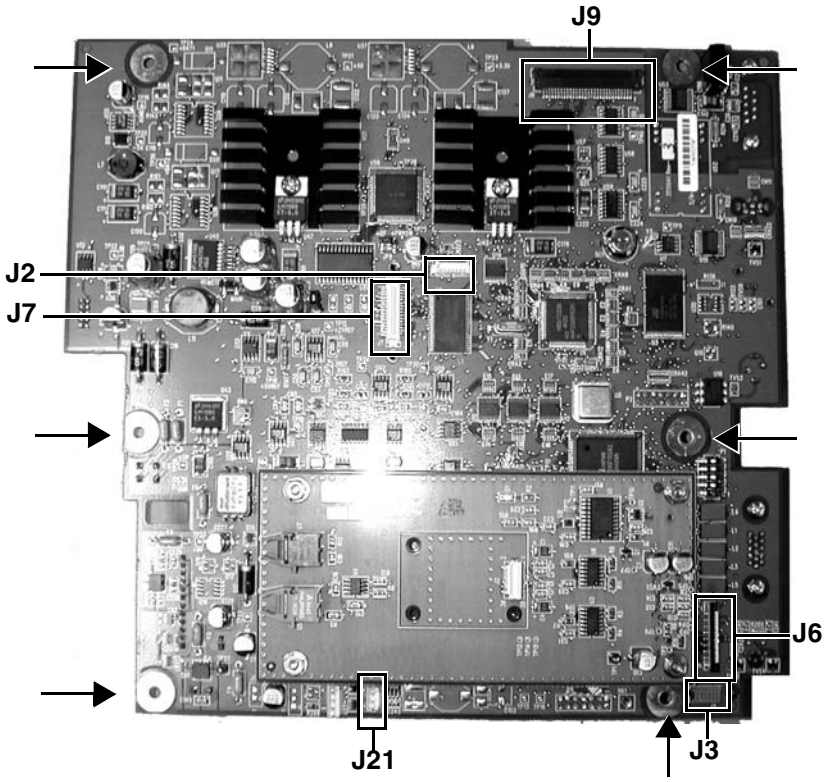


Figure 10-20: Main PCB Screws

3. Disconnect the printer cable from J9 on the Main PCB.

4. Label and disconnect the speaker cable at J21 on the Main Board.

5. Carefully pull the Main PCB away from the front chassis. The board only pulls forward slightly.

   NOTE: PS2 is on the solder (back) side of the Main Board.

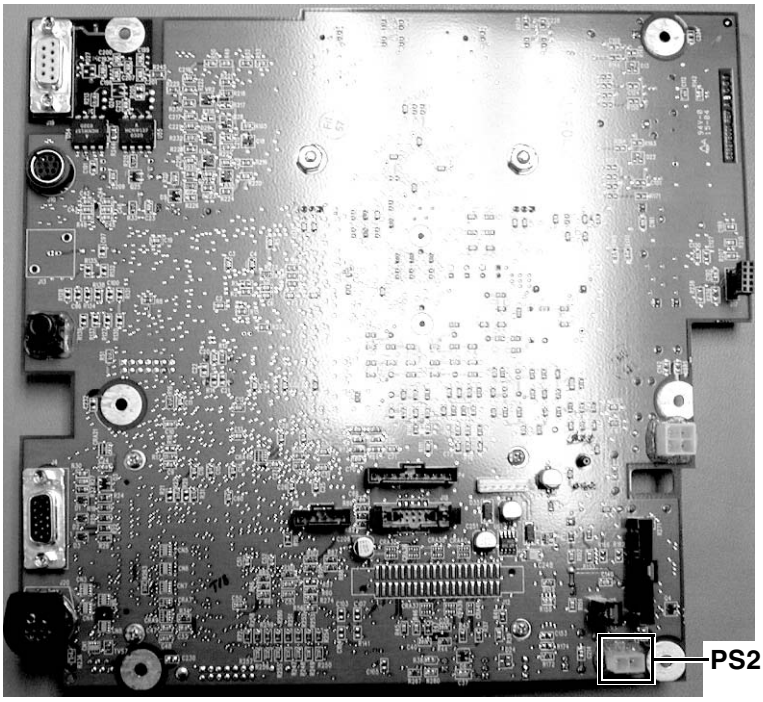


Figure 10-21: Main Board Solder Side Connections

6. Label and disconnect the Power Supply PCB cable at PS2 on the Main Board.

7. Replace in reverse order.

Front Chassis Removal

The Main PCB is attached to a metal chassis. You can remove this PCB as an assembly.

NOTE: MEDRAD advises that you remove the Main PCB prior to removing the Front Chassis. See “Main PCB Removal and Replacement” on page 10-14.

1. Remove the printer from the remote display. See “Printer Removal and Replacement” on page 10-13.

2. Remove the two (2) Philips screws hidden beneath the printer module.

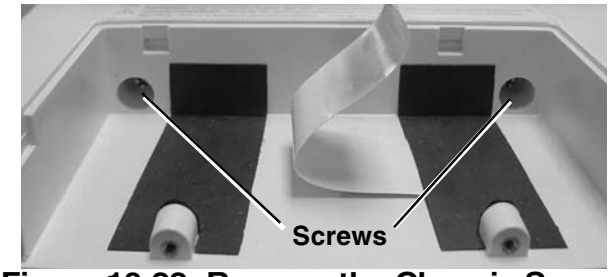


Figure 10-22: Remove the Chassis Screws

3. Turn the remote display over and remove the two (2) bottom screws and the two (2) feet.

4. Gently pull the front chassis from the rear housing.

Figure 10-23: Remove the Front Chassis

5. Label and remove all cables from the front.

6. With a 1/4-inch deep well socket, remove the two (2) Power Supply PCB ground cables.

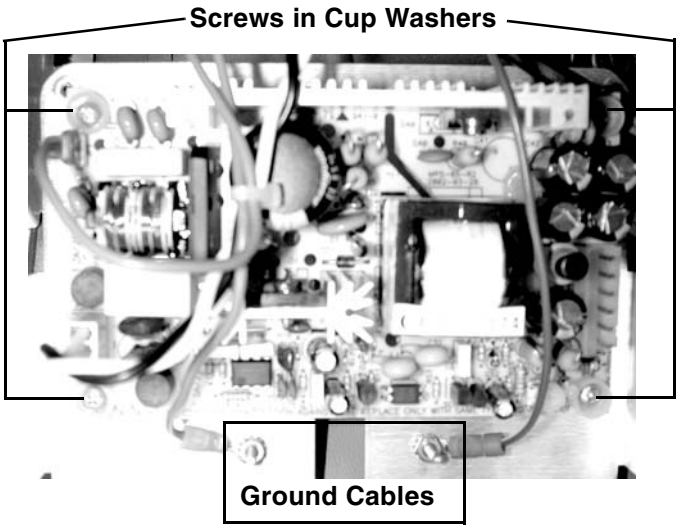


Figure 10-24: Power Supply PCB Assembly

Power Supply PCB Removal and Replacement

1. Remove the four (4) screws and cup washers.

2. Remove the AC cable from J5, the AC In cable from CN1, and the Ground cable from JP1 on the Power Supply PCB.

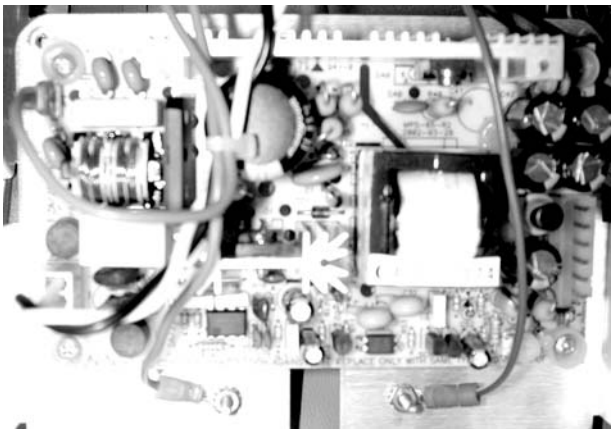


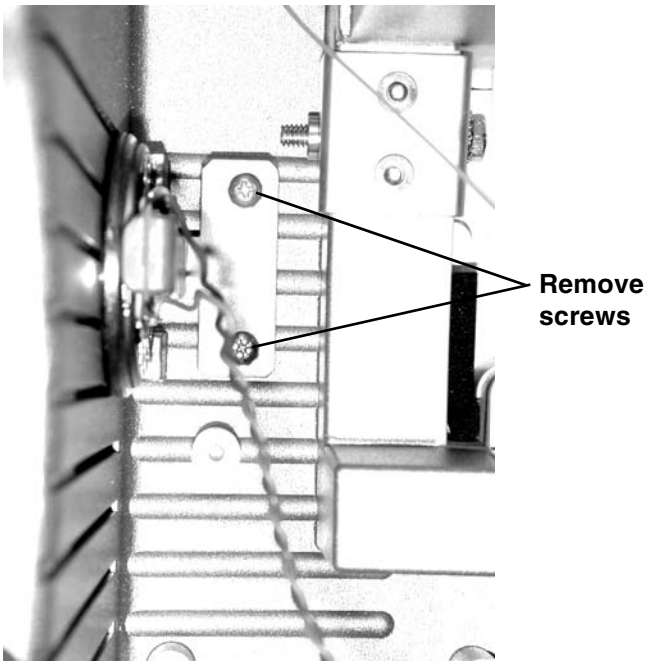
Figure 10-25: Power Supply PCB Connections

3. Reassemble in reverse order.

4. Reassemble the remote display.

Speaker

1. Remove the two (2) screws at the back of the chassis.



2. Slide the old speaker out.

3. Reassemble in reverse order.

11 *Remote Display BOMs and Drawings*

List of Drawings	Title	Drawing Number
Assembly BOMs and Drawings	Remote Monitor Final Assembly	3010482
	Rear Housing Assembly	3010643
	Front Housing Assembly	3010644
	Remote Front Display Assembly	3010655
	Chassis Assembly	3010645
	Printer Module	3012890
	Veris Remote Main Board Assembly	3011535

Remote Monitor Final Assembly 3010482 REMOTE MONITOR ASSEMBLY

Item #	Part Number	Description
01	3010643	HOUSING REAR REMOTE ASSY
03	3010644	HOUSING FRONT MONITOR ASY
05	3010645	CHASSIS REMOTE ASSEMBLY
09	3011535	MAIN PCB REMOTE
17	3012890	PRINTER MODULE 8100/9100
18	3010973	DPAC COMMUNICATIONS BRD
61	3010950	ENGLISH REMOTE LABEL SET
	3012493	FRENCH REMOTE LABEL SET
	3012494	GERMAN REMOTE LABEL SET
	3012495	JAPANESE REMOTE LABEL SET
	3012496	SPANISH REMOTE LABEL SET
	3012497	PORTUGESE REMOTE LABEL SET
	3012498	ITALIAN REMOTE LABEL SET
	3012499	SWEDISH REMOTE LABEL SET
	3012500	DUTCH REMOTE LABEL SET

Front Housing Assembly MR3010644 HOUSING FRONT MONITOR ASY

Item #	Part Number	Description
01	3010650	HOUSING FRONT REMOTE
02	3010655	DISPLAY FRONT MONITOR AY
10	3010657	MEMBRANE SWITCH MONITOR

Remote Front Display Assembly MR3010655 DISPLAY FRONT MONITOR AY

Item #	Part Number	Description
01	3010654	DISPLAY BEZEL FRONT

Rear Housing Assembly	3010643	HOUSING REAR REMOTE ASSY

Item #	Part Number	Description
01	3010651	HOUSING REAR REMOTE
06	3010663	CABLE POWER ENT 2 PWR SUP
09	3010648	COVER BATT OPENING REMOTE
22	3011499	ST SPLICE BUSHING
23	3011476	FO INT COMM DUPLX CBL
59	3012493	FUSE 3A PICO 125V SLO-BLO

Chassis Assembly	3010645	CHASIS REMOTE ASSEMBLY

Item #	Part Number	Description
01	3010646	CHASSIS BOTTOM REMOTE
02	3010647	CHASSIS VERTICAL REMOTE

Printer Module	3012890	PRINTER MODULE 8100/9100

VIE
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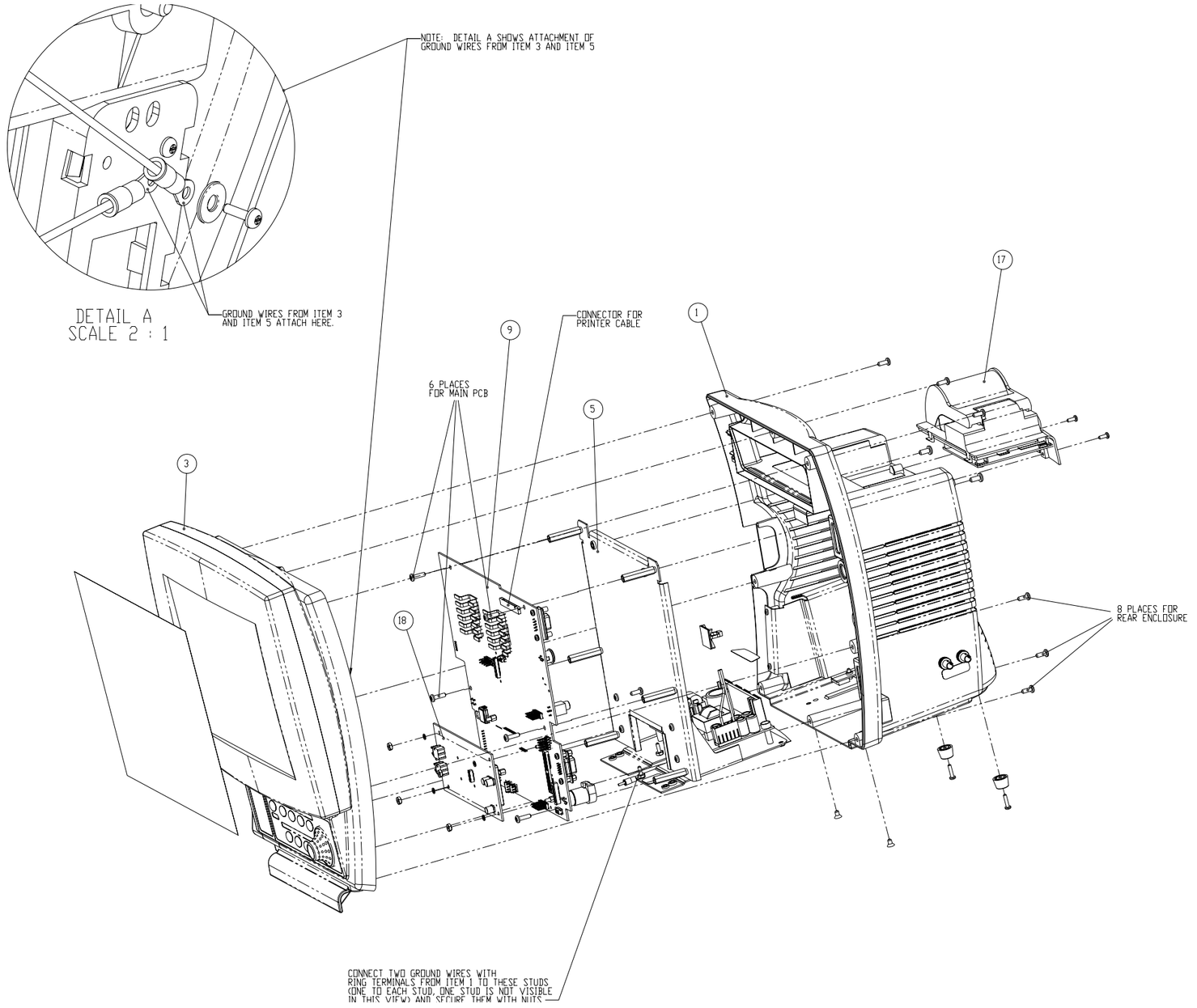
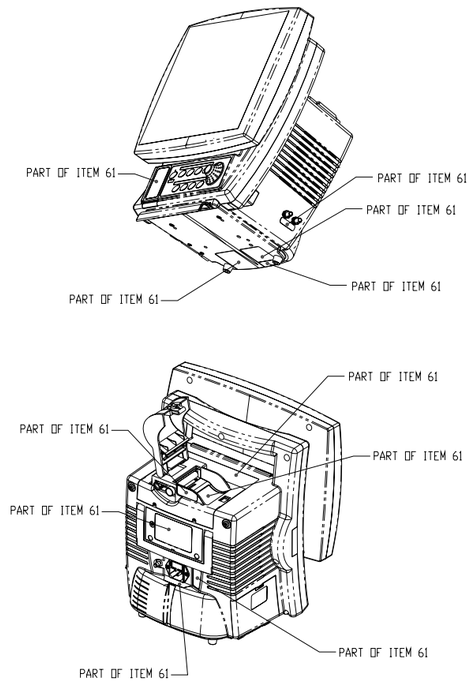
Remote Final Assembly
(3010482)


NOTE: DETAIL A SHOWS ATTACHMENT OF GROUND WIRES FROM ITEM 3 AND ITEM 5
DETAIL A
SCALE 2 : 1
GROUND WIRES FROM ITEM 3 AND ITEM 5 ATTACH HERE.
CONNECTOR FOR PRINTER CABLE
6 PLACES FOR MAIN PCB
8 PLACES FOR REAR ENCLOSURE
CONNECT TWO GROUND WIRES WITH RING TERMINALS FROM ITEM 1 TO THESE STUDS (ONE TO EACH STUD, ONE STUD IS NOT VISIBLE IN THIS VIEW) AND SECURE THEM WITH NUTS
1
3
5
9
17
18


PART OF ITEM 61
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NOTES:

1. ASSEMBLE PER ASSEMBLY PROCEDURE 3010482P.

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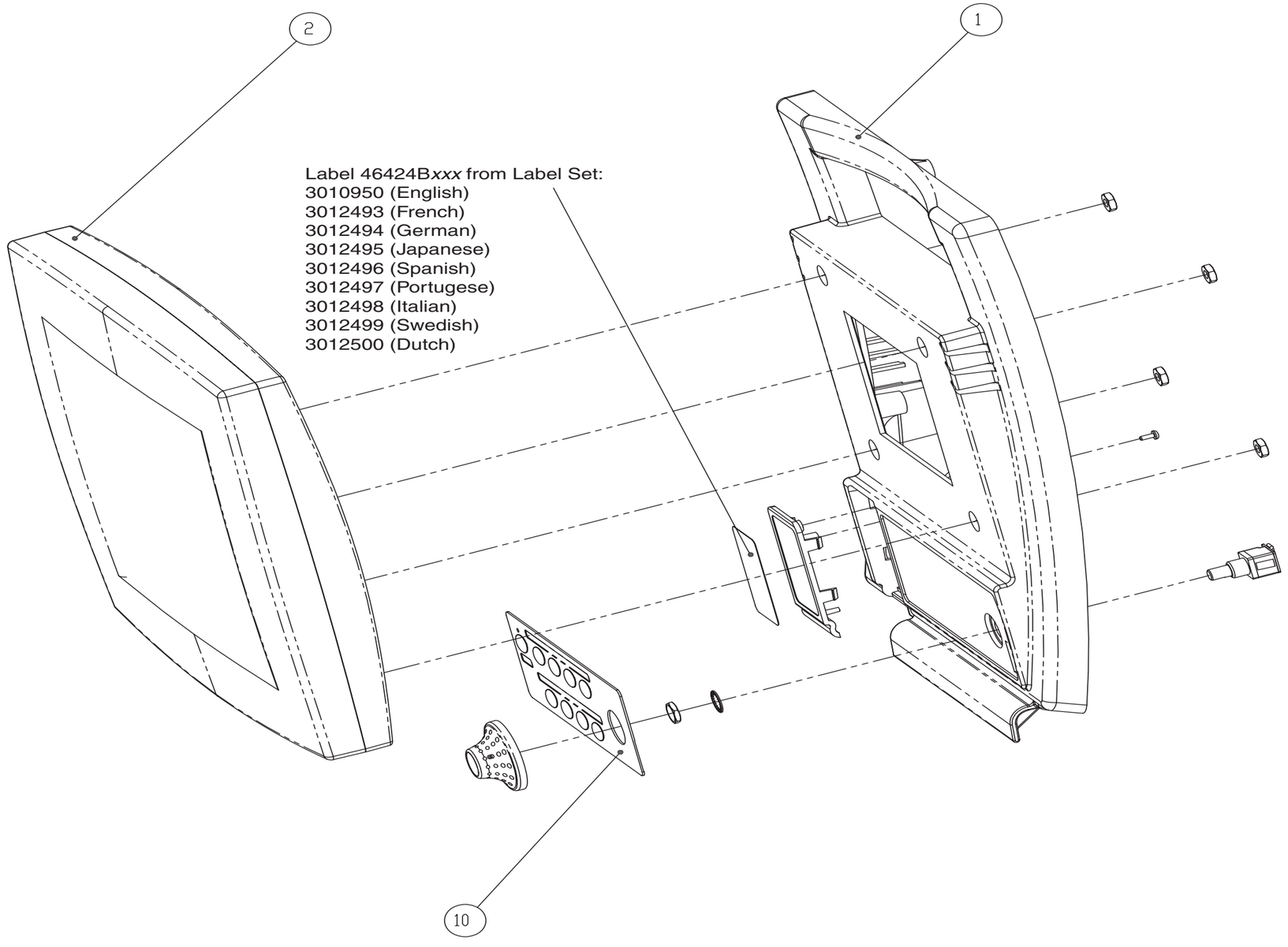
Remote Front Housing Assembly (3010644)



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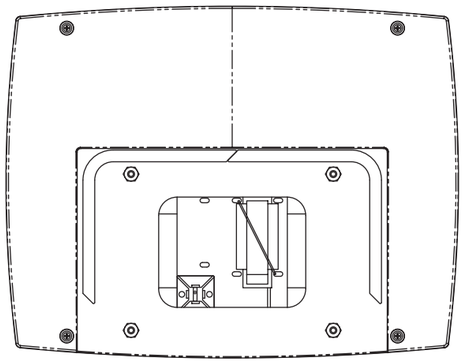
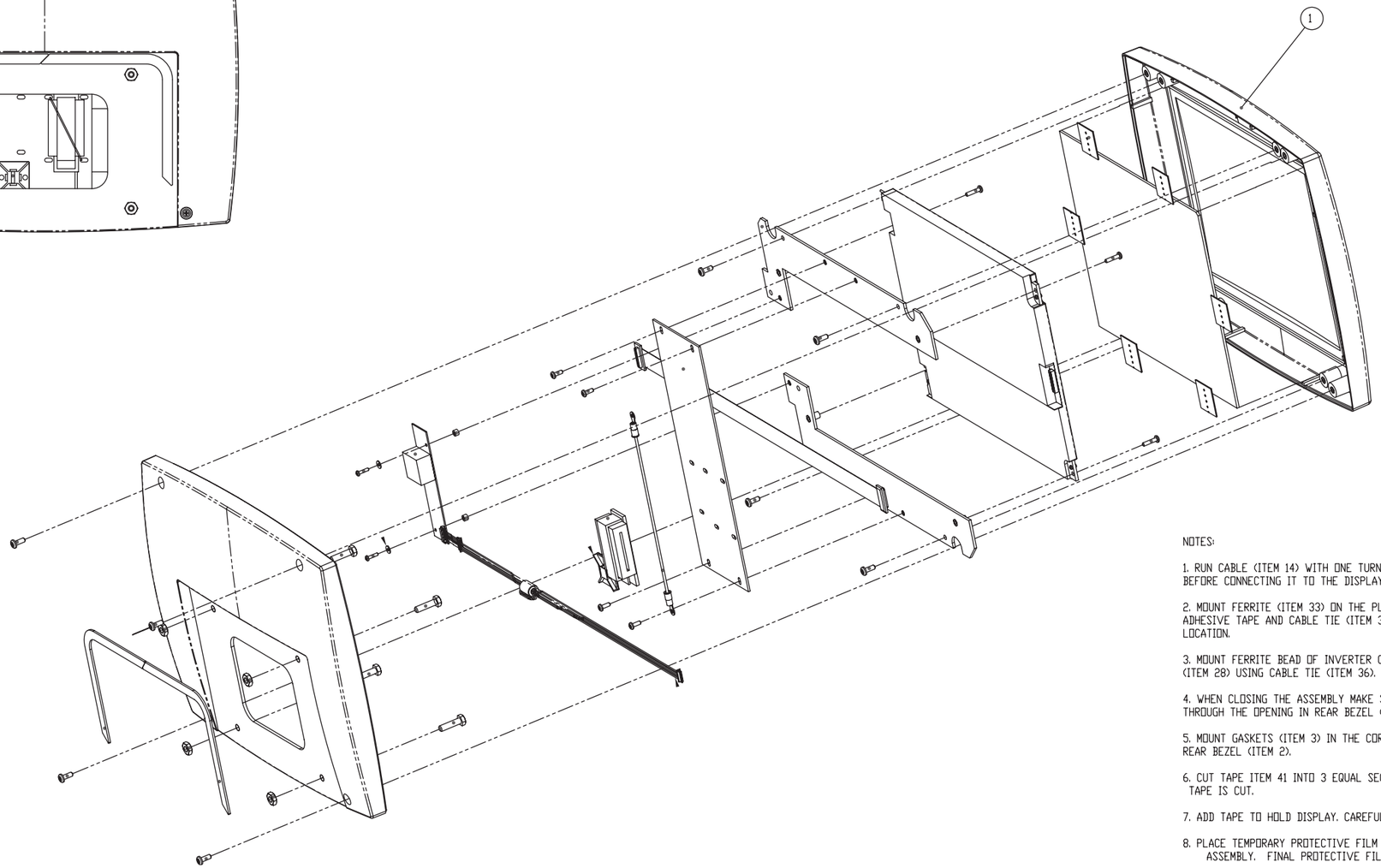
Remote Front Display Assembly (3010655)





NOTES:

1. RUN CABLE (ITEM 14) WITH ONE TURN THROUGH FERRITE (ITEM 33) BEFORE CONNECTING IT TO THE DISPLAY (ITEM 9).

2. MOUNT FERRITE (ITEM 33) ON THE PLATE (ITEM 7) USING ITS OWN ADHESIVE TAPE AND CABLE TIE (ITEM 37)- SEE REAR VIEW FOR TIE LOCATION.

3. MOUNT FERRITE BEAD OF INVERTER CABLE (ITEM12) ON THE HOLDER (ITEM 28) USING CABLE TIE (ITEM 36).

4. WHEN CLOSING THE ASSEMBLY MAKE SURE ALL CABLES ARE GOING THROUGH THE OPENING IN REAR BEZEL (ITEM 2).

5. MOUNT GASKETS (ITEM 3) IN THE CORNERS OF THE DEPPRESSION IN REAR BEZEL (ITEM 2).

6. CUT TAPE ITEM 41 INTO 3 EQUAL SECTIONS. THERE WILL BE 6 TOTAL AFTER TAPE IS CUT.

7. ADD TAPE TO HOLD DISPLAY. CAREFUL NOT TO PLACE TAPE OVER WINDOW.

8. PLACE TEMPORARY PROTECTIVE FILM FROM NEC DISPLAY ON FRONT OF ASSEMBLY. FINAL PROTECTIVE FILM WILL BE APPLIED AT FINAL INSPECTION.

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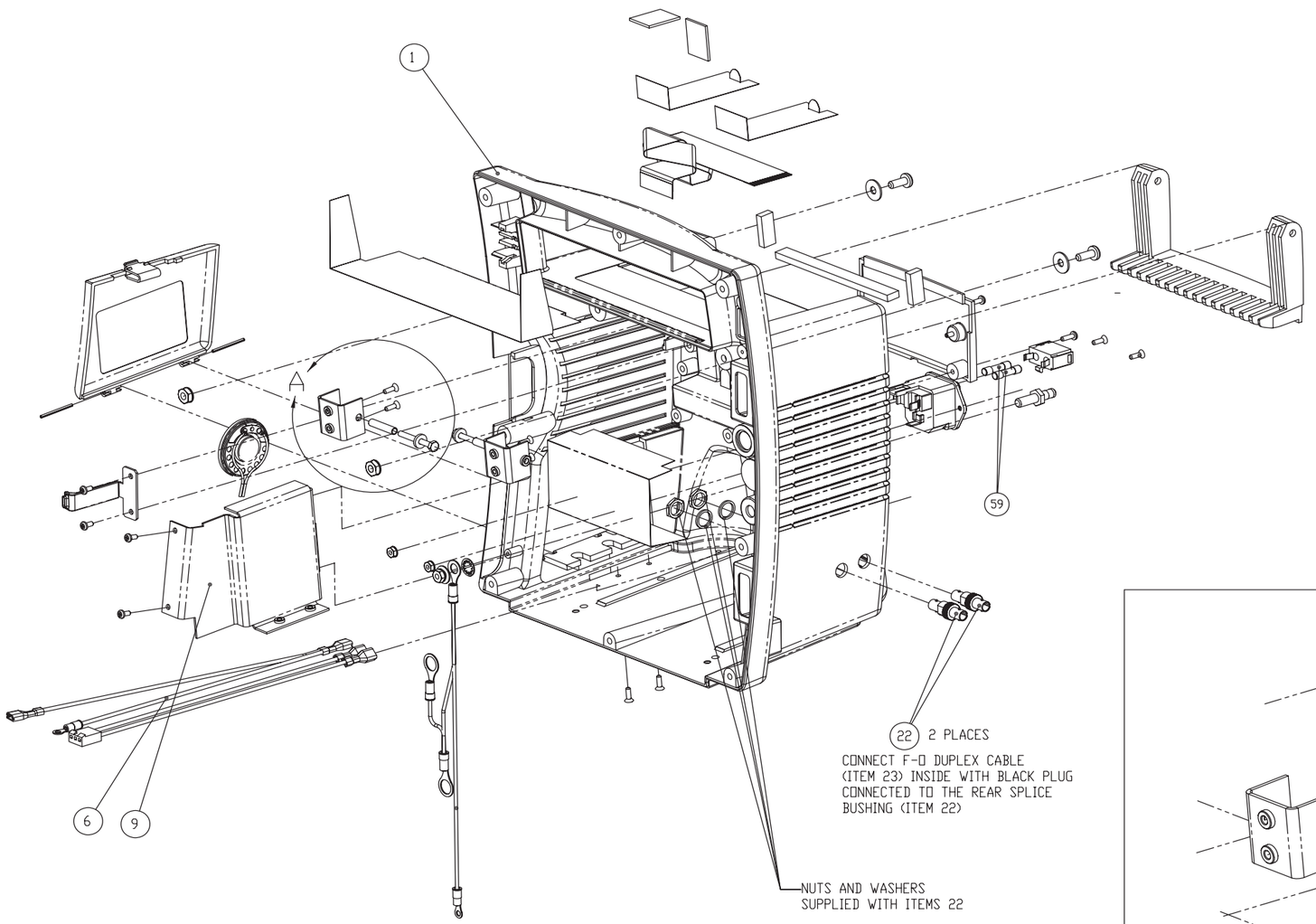
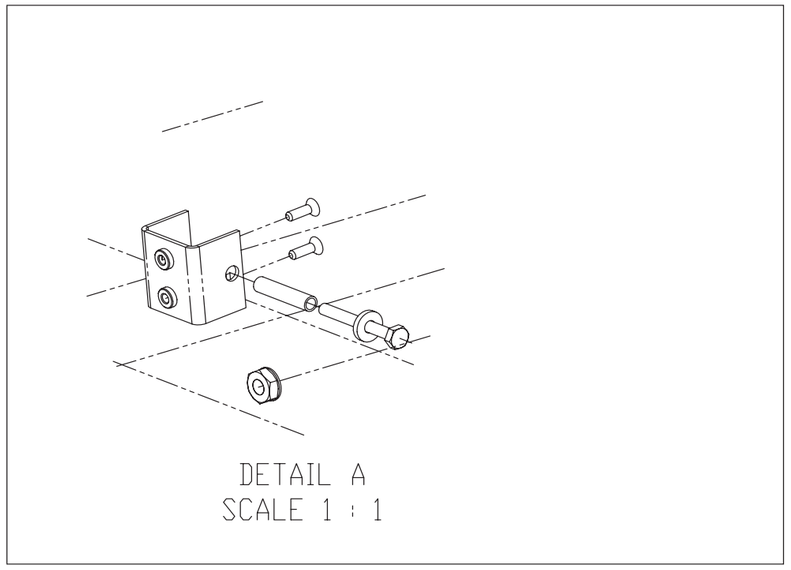
Remote Rear Housing Assembly (3010643)


1
59
22
2 PLACES
CONNECT F-O DUPLEX CABLE (ITEM 23) INSIDE WITH BLACK PLUG CONNECTED TO THE REAR SPLICE BUSHING (ITEM 22)
6
9
NUTS AND WASHERS SUPPLIED WITH ITEMS 22



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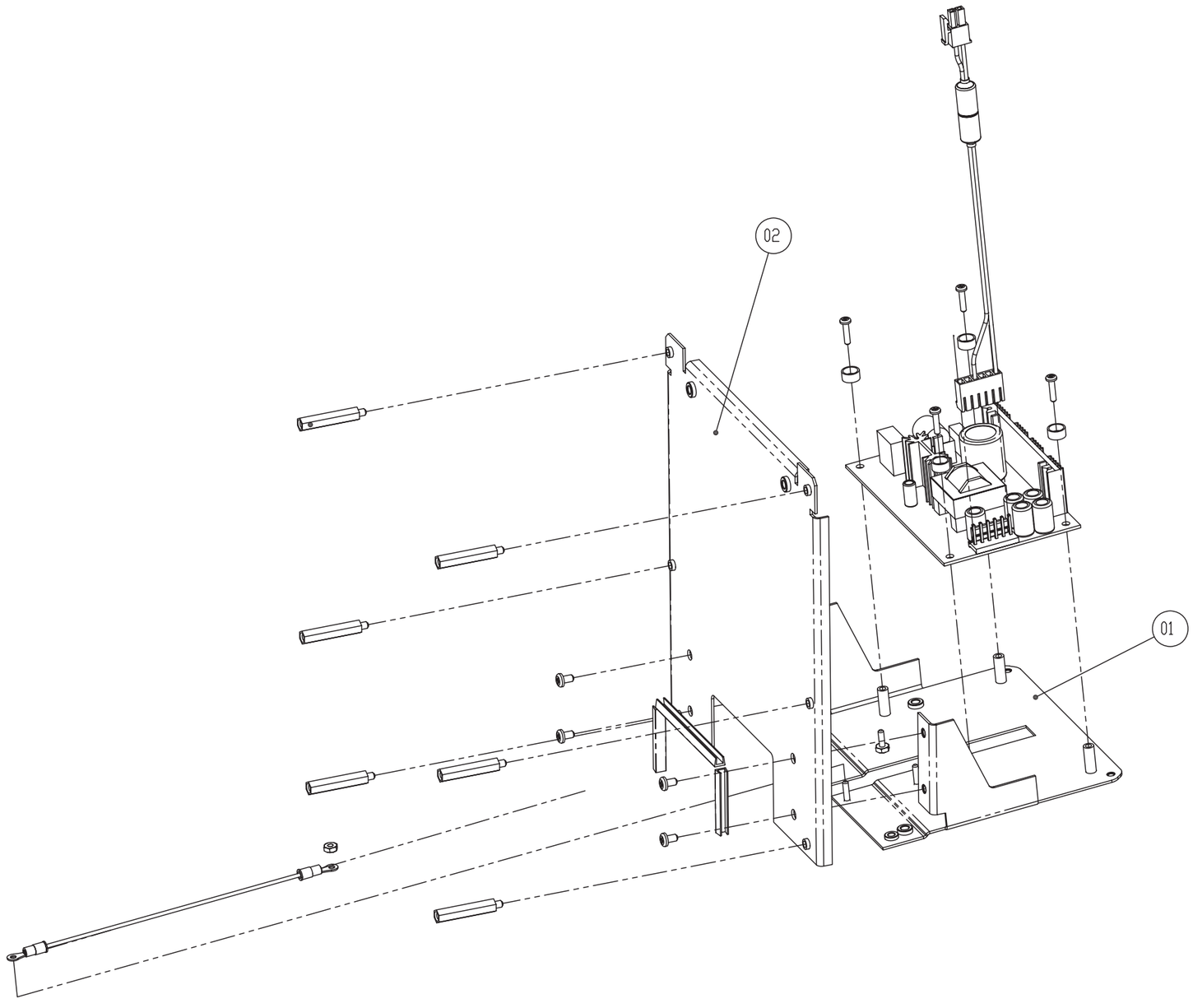
Remote Chassis Assembly
(3010645)



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